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Is This the Commissions' Attitude?

WHAT would have impressed a casual visitor most at the valuation conference held in Washington last week by the Division of Valuation of the Interstate Commerce Commission was the violent opposition of the State railroad commissions to the valuation theories of the railroads. One would not have been surprised at an occasional disagreement, but the regularity with which the State commissions' chief representative took issue with the railroad point of view suggested a court trial, with the railroads the defendants and the prosecuting attorney permitted and expected to break down or belittle if possible all testimony for the defense. Is it true that the State commissions do officially so regard the railroads—guilty until proved innocent, and criminals whose every act is to be regarded with suspicion? To this journal this alignment of the forces seems entirely improper; the railroads are fighting for what they consider their rights, while the State commissions are arbiters of justice, supposed to be equally jealous of the rights of both the railroads and the public.

Muddled Theories

HOW readily one sees things as one wishes to see them was repeatedly shown in the valuation conference just referred to. Both the railroads and the State commissions were guilty of inconsistencies, of mixing their theories. The question of assuming present or original conditions in figuring reproduction cost new was a stumbling block for both sides. The railroads would allow for clearing and grubbing if the evidence showed that this had to be done when the road was built, while the State commissions would make the allowance only if the adjacent land was still forested. The railroads would allow damages for imaginary apple trees if orchards stood alongside the right of way at the time of valuation, while the commissions would make no such allowance. In other words the railroads would assume both original and present conditions and have a forest and an orchard on the same piece of ground, while the commissions would assume neither original nor present conditions, but would have the tract a barren waste all ready to be graded. Both sides stated, on the first day of the conference, their interpretation of "reproduction new" to be the reproduction anew of the identical existing plant as it would reasonably be reproduced—not an imaginary property that never did exist, with all the component parts brand-new. Both sides, before the end of that day, advanced propositions that violated that interpretation. On the ground that "reproduction new" must be reproduction *new* the railroads asserted that sidings should be considered as laid with new rail, even though re-lay was actually used. The State commissions properly insisted that what the rail was when placed in its present position must govern. On the other hand, the commissions attempted to sweep out of court all arguments for allowance for solidification of an old embankment on the astonishing ground that an embankment reproduced new would not yet have so solidified and appreciated. It seems to this journal that both sides will strengthen their positions if they will analyze their own theories carefully and then stick to them, even in individual cases where they lead to loss instead of profit.

Name Changing on the Canal

IN the Engineering Record of May 22 there appeared a letter suggesting the changing of the name Gatun to Sibert. A rather tart criticism—too tart to be published—of name-changing on the Isthmus, addressed to this journal, suggests the advisability of a few plain words on the subject. There were many men responsible for the success of the work at Panama, too many to be given recognition geographically unless the Isthmian map were plastered with new names. Any reasonable (whatever that is in a matter of this kind) name-changing, therefore, will be sure to hurt the feelings of those slighted and of their friends. It will cause gossip, unkind gossip, and charges of favoritism. Moreover, any name changes would undoubtedly give recognition to the services of the military rather than the civilian engineers and would thus revive the criticism, largely just, which has been leveled at the distinction already made. Therefore, this journal is opposed to name-changing on the Isthmus. It cannot endorse Sibert for Gatun, nor can it show enthusiasm for Gaillard as a substitute for Culebra. If credit for that work had been properly given the name of Rourke, present commissioner of public works of Boston, who was responsible for the organization at Culebra, would have been linked with that of Gaillard.

The Temper Toward Business

JUDGE GARY, chairman of the United States Steel Corporation, in his address before the Iron and Steel Institute last week expressed the belief that the inimical attitude of the public toward business, so evident over a period of recent years, has now altered materially. The old view that all big business is criminal seems to be passing and legislators are not so ready to enact laws aimed at curbing business activity. To this cause, in part, Judge Gary attributed a better outlook for improvement in the steel industry than has existed for more than a year. With his opportunity to study the business and legislative situations, few men in the country are as well qualified to give such an opinion as he. It is encouraging, to say the least, though many will have to put aside their own judgment ruthlessly in order to accept with full faith Judge Gary's conclusion. This journal, traditionally optimistic and constructive, does not look for any material improvement in the character of legislation in the near future. The cry against business is still good capital for the campaign orator, while many refuse to believe the statistics which show that oppressive legislation curtails profits and has a tendency to lower wages. Fortunately, this is being forced home upon railroad employees. The two most recent arbitrations brought them very little—in fact, in the last arbitration, at Chicago, the gains were insignificant. When this method of education—the practical demonstration of the close relation between wages and successful business operation—is extended broadly a material change in the public temper can be expected. Until then, this journal believes, the gains will be small, although, small as they are, Judge Gary deems them important and a factor in early business improvement.

Safety First

IN ACCEPTING last week the presidency of the Safety First Federation of America, Darwin P. Kingsley, president of the New York Life Insurance Company, emphasized the necessity for educational efforts in order that the Safety-First campaign may be effective. While the educational work to which he had reference is that which will bring the public in general to an appreciation of the need for proper laws and ordinances governing safety on the streets, in a larger sense educational work is the sole hope for effectiveness in the movement, even as applied to factories and individual occupations. At the start Safety-First activities were believed to stop with the posting of danger signs, the issuance of pamphlets, more or less fragmentary, laying down rules to be observed in hazardous occupations, and the enclosing of belts, gears and cutting tools whereever possible. It is beginning to be appreciated that while these measures are desirable it is far more necessary that through repeated instruction and the vigilance of foremen, trained to an appreciation of the dangers of their occupations, the workers themselves be brought to a lively sense of their duty to themselves, their families and their employers with reference to avoidance of accidents whether to themselves or to others. Disciplinary measures, too, there must be, but primarily results are to be sought by educational methods. So great is the need for educational direction in this work that one of the committees of the National Association of Corporation Schools has taken the matter in hand and will report on the methods employed in progressive plants at the convention in Worcester, Mass., early next month. The subject is one that deserves the careful consideration of executives of transportation and industrial enterprises no less than of those agencies which are aiming to bring the public at large to a clearer sense of the part it can play in the Safety-First movement.

Excellent Student Journalism

THOSE who have not an opportunity of seeing the best of the quarterly and monthly journals published by the students of leading engineering colleges have little conception of the high-class work being done. The small, poorly conceived and poorly edited sheets are still in the great majority, but here and there are publications that one hesitates to class as "amateur engineering journalism." They contain well written and well edited engineering articles and the typographical presentation is above criticism. As is to be expected, however, even the best of them are weak editorially, for it is obvious that the undergraduate has not the breadth of view of the seasoned practitioner. Probably the results would be better if editorial expression were limited to questions of moment in student life, to the co-operation possible between the alumni and the college, and similar topics. In news handling, too, the best of them are weak, and the accounts of student and department activities rather discouraging to him who would keep in touch with the technical department of his alma mater through its engineering publication. Recently the "Cornell Civil Engineer" covered itself with glory by getting out a special souvenir number, reporting the activities and papers of the first annual Cornell good-roads week. The issue combines the March and April numbers and makes a book of 262 reading and 28 advertising pages. It is a valuable volume for the highway engineer and is a tribute to the initiative and energy of the student organization, the Association of Civil Engineers of Cornell University, responsible for it. The "Michigan Technic" also made a departure recently that is worthy of special commendation. Heretofore a heavy technical magazine, it has now come to appreciate that there is much news in the engineering college, regarding the faculty, the students, new equipment, experimental and thesis work, etc., of interest to the alumni. It has, therefore, expanded this feature, giving it a human interest that is sure to make new and numerous friends for it among the engineering alumni of the University of Michigan. Space does not permit a word regarding some of the other strong student engineering publications. The two mentioned, however, should serve to stimulate the weaker papers to adopt higher standards. What Cornell and Michigan have accomplished others can do, and once there is a clear conception of the possibilities the execution can be left, without comment or urging, to the resourcefulness of American student bodies.

Reinforced-Concrete Slab Formulas in New York Code

IN the proposed revision of the New York building code, now being drafted by a committee of the Board of Aldermen, the preliminary draft of article 17, on fireproof construction, contains the following proposed method for the design of reinforced-concrete slabs of a thickness limited to 1/18 of their span, and of a specified minimum of 4 in.: "In determining the safe carrying capacity of concrete-slab floor fillings the gross load in pounds per square foot of floor surface shall not exceed the product of the depth in inches of the reinforcement below the top of the slab, by the cross-sectional area in square inches per foot of width of the tensional steel, divided by the square of the span in feet, all multiplied by the following coefficients: When cinder concrete is used 14,000, if the reinforcement is not continuous over the support; 18,000, if the reinforcement consists of rods or other shapes securely hooked over or attached to the supports, and 26,000, if the reinforcement consists of steel fabric continuous over the support, and, when stone concrete is used, 30,000 and 40,000 respectively." In the same section it is stated that unit stresses of 300 in cinder concrete and 16,000 in the steel shall not be exceeded when the design is based upon the "usual methods of calculation."

The empirical coefficients here proposed are based upon results of tests of floor slabs, upon previously approved floor-slab construction, and, in the case of cinder concrete, upon the tests reported by Harold Perrine and George E. Strehan in a paper in the "Proceedings" of the American Society of Civil Engineers for February, 1915. A study of these formulas makes it evident that they depart radically from usual practice in the design of floor slabs. They can be expressed in the form $w = K\ A\ d/\ L^2$. In order to determine the value of the constant k in the usual formula for bending, $M = w\ L^2/k$ (in which k is 8 for simple beams, 10 for partially restrained beams, and 12 for continuous beams) in terms of the given constant K of the proposed code, assume the effective depth at $7/8\ d$, use 16,000 for the stress in the steel and equate resisting moment to bending moment. There is obtained $w = 1{,}167\ k\ A\ d/L^2$. Therefore, $k = K/1{,}167$, and for the cases given there results for cinder concrete, $k =$ 12 for simple beams, 15.4 for partially restrained beams and 22.3 for restrained beams. For stone concrete the values are 25.7 and 34.3 respectively.

While these relatively very low values for equivalent bending moment may possibly be justified by results of experiments, owing principally to arching action of unknown amount dependent directly upon the spacing of beams (which should be limited in the proposed revision), it is questioned whether this radical departure from usual conservative design is sufficiently justified by scientific test data. There is obviously no chance for the engineer who designs according to usual methods using the allowable unit stresses to compete with the builder or architect who uses the proposed empirical formulas.

Exploiting John Jones, Laborer

IF OUR industrial problems are reduced to their simplest terms, we will find that an essential difficulty is to put the man in touch with the job. At least this is the conclusion, in substance, drawn by Leonora Z. Meder, commissioner of public welfare for the city of Chicago, in her first semi-annual report. In studying Chicago's labor agencies, of the total of 1137 men studied, 100 were selected as being typical of the entire number, and these, in turn, represented Chicago's huge army of seasonal laborers.

The 100 men paid fees for 371 different jobs or an average of 3.71 jobs each, one man paying as high as $62.50 for jobs during one season. The heavy inroads the payment of these fees make on the earnings of John Jones, average laborer, may be readily conceived when one stops to consider the wages of $1.50 or $1.75 per day paid unskilled labor last year for railroad construction work. In this consideration lost time, for which no pay was received, but during which they were required to pay board, must not be forgotten.

Most of the agencies deal with foreign labor almost exclusively and with few exceptions, says Chicago's welfare commissioner, they all declare they would rather handle foreign labor than the so-called "white labor"—native born workmen or men from northern Europe. They say that the "white" laborer is almost always unreliable, that he will not stay at work, that he refuses to board himself, and misuses transportation. This may be true, but the fact that white labor is not so easily exploited may have a bearing on the preference of the agencies.

The labor agents' arithmetic is said to be something like this: If each man works one year, then ten men for ten jobs at $10 apiece equals $100 in fees. If each man works six months, then you have twenty men for ten jobs at $10 apiece, which equals $200 in fees. Moreover, according to the philanthropic agent's way of thinking, he is giving more men a chance to work.

The agencies dealing with clerical and skilled labor are also touched on in the report. While the complaints are not so numerous against this class of agencies, some of them employ tactics which can hardly be said to be fair. For instance, the agency inserts an advertisement in a paper, and secures a number of applications when it has only a few positions at its disposal. As each application must be accompanied by a registration fee which need not be returned for 30 days, it is quite a burden to the applicants, as it ties up their money when they need it most.

All employers agree that a free employment agency does a good work if it is properly conducted. A man's labor is oftentimes his only valuable possession and the

State should protect it, not only because it is better equipped to do this work than private parties but because it has the confidence of both employer and employee.

England and Germany have tried government regulation and found it successful. What will come of our experiment under the Department of Labor only time can tell.

The labor problem has long been a serious one and engineers and contractors would do well, as opportunity is afforded, to exercise their influence in favor of plans that will protect the men, particularly the unskilled, and thus make smoother the way that, at best, is none too easy.

Commission vs. Single-Headed Departmental Control

THE recommendations made by the committee of engineers to the New York Constitutional Convention (see Engineering Record, May 1, 1915, page 561) have, with one exception, met with general approval, if one is to judge by the favorable comments and the absence of adverse criticism. The exception is to the recommendation that the Department of Engineering and Public Works, to have charge of all engineering functions of the State, be under a three-headed commission. The objection comes not to the consolidation of engineering bureaus and departments now widely scattered, but to commission rather than single-headed control. The opposition to the recommendation, too, is not, apparently, from any great number of engineers. Besides the societies originally represented on the committee, the Rochester Engineering Society has recommended the same form of organization, while the Albany Society of Civil Engineers has not stipulated the type of head for the new department, other than that he must be an engineer or that the majority must be engineers if a commission is to have charge.

It is patent that the committee of engineers making the recommendations first referred to gave most careful consideration to the form of organization for this consolidated department, and while many of the members favored, theoretically, a single head, it was felt that with New York politics as they are, continuity of policy or personnel was impossible with such an organization. So important was consistency of policy deemed that unanimously the committee agreed upon the three-headed commission, so organized that each Governor would appoint only one member. It is recognized, of course, that with this form of organization the department would not be as responsive to the Governor as under a single head appointed by that executive, and, in this respect, the recommendation runs counter to the "short ballot" theory, which the committee has endorsed and which bids fair to receive the approval of the convention. Individual cases, however, must be judged by controlling circumstances and when, as has been found in New York, political conditions are not such as to favor efficient administration, theory must yield to the greater wisdom of experience. Furthermore, it is patent that the Governor's influence will be felt. He will have one appointee on the commission, while at all times he will have the privilege of making such investigations into the operation of the department as he may desire.

Engineers will be well advised to stand back of the recommendation of the committee as made. If adopted it should result in a steadying influence missing in at least some of the engineering departments of New York State at the present time.

Another Field for Sanitary Engineers

NEW FIELDS are daily opening up for the general practising engineer. Public-utility commissions have been absorbing large numbers of men, especially for valuation work, and the city-manager form of government offers new opportunities. The sanitary engineer, however, has seen no particularly new fields of activity for some time. Recently he has become identified with county officials, and it is, therefore, with some degree of satisfaction that this journal records the receipt of the first annual report of the department of sanitary engineering in Lucas County, Ohio, in which Toledo is situated. As the office was established to render public service in a new field, a brief history of its development seems pertinent, particularly since there are other counties with large populations outside of incorporated limits but with problems too local to be handled by State board of health officials.

In Lucas County, 50,000 of the 70,000 rural population live in the immediate vicinity of Toledo. This community, one-quarter of the size of the incorporated city, grew up outside the jurisdiction of any municipality, but because of the scattered area covered, could not be incorporated as a single municipality, and there was no recognized method of procedure whereby public improvements could be secured through public action. State laws required the abatement of aggravated sanitary conditions without providing a mode of procedure. Study of the individual cases showed the necessity for a comprehensive scheme for all future sewers.

State laws, passed in 1913, empowered the county commissioners to establish sewer districts outside of incorporated cities, to build and to maintain sewers and disposal plants. Supervision by a sanitary engineering department was also specifically provided for. While the commissioners may proceed of their own volition, all action thus far taken in Lucas County has been the result of petition. Moreover there are on file more petitions than can be cared for. In fact, the only serious complaint is that the department is unable to do more. So far six districts have been formed. Plans have been prepared and construction carried out for four storm-water drains and nine sanitary sewers, totaling about 20 miles, while three disposal plants have been designed.

Of special interest in connection with this development is the provision in the law for maintenance. This point should not be overlooked by any State empowering county commissioners to build sewers and disposal plants, for construction funds are thrown away if operating expenses are not provided for. Engineers who live in suburban districts can render a definite service to their fellow citizens by pointing out the possibilities of co-operative effort in thus obtaining desired improvements which otherwise would be unattainable.

The Way to Professional Success

IN the article of Mr. Bunnell in the last issue of this journal and in the abstract of the address by Professor Baker in this issue, page 722, the Engineering Record believes it has published two most excellent commencement addresses. In fact, it doubts whether any better guides for the young engineer will be given them in the addresses which will be delivered the country over during the next two weeks. The papers in question, too, were not intended by their authors as commencement speeches, but no one can read their clear statements of the essentials of professional success without feeling that their words may well form a guide to the engineer throughout his life's work. Further, they are not prosy papers. Short, to the point, they will be heeded by the active, bright-eyed young men already out of college and about to be graduated, on whom America's engineering future will rest.

Both men emphasize most strongly the need for broadening one's horizon, of preparing one's self for the largest places by being posted not on design solely, nor on construction, but on both of these phases of engineering and, in addition, on the economics which must form the groundwork of all successful engineering enterprises.

The burden of Mr. Bunnell's argument is that the school cannot give the individual the whole training necessary for success. This is obvious. Not only are the specialties too diverse to be covered by the school work, but the standards of professional life are so different from those of the college that the latter can never hope that its training will supplant experience. Mr. Bunnell rightly concludes, therefore, that since the school cannot give the individual all the training he needs, the individual must secure it of his own initiative after school days are over.

He places especial emphasis, too, upon the necessity for considering the engineer's first work as an apprenticeship, a broader schooling which should fit the young man to select more intelligently the road along which he is to travel to professional success. Therefore, his strong urging that the greatest care be exercised in selecting the first position. In these dull times, of course, the choice may be restricted.

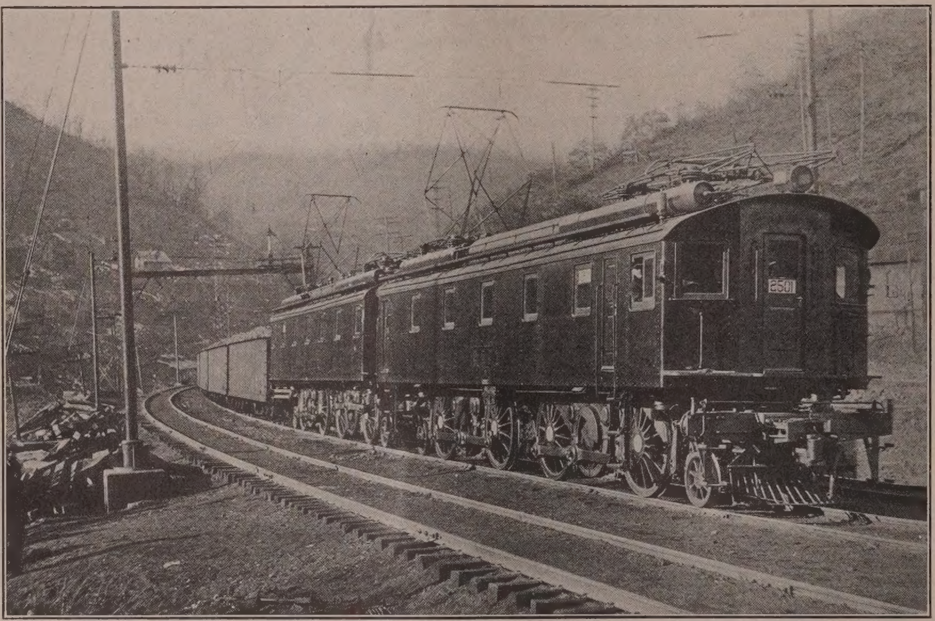
Professor Baker, equally insistent upon clear appreciation of the many sides of engineering, including its financing and its other economic problems, points to the need of a knowledge of affairs if the individual is to attain a rounded development.

Most heartily will the readers of the Engineering Record say "Amen" to these views.

New Field for Railway Electrification Has Been Developed by the Norfolk & Western

Electric Power on Short Mountain Section Decided Upon Primarily for Assembling Coal Cars from Sidings All Along Route—Sharp Curves Complicate Overhead Catenary System

A NEW FIELD for railway electrification has been developed by the Norfolk & Western Railway on the 30-mile mountain section in West Virginia between Bluefield and Vivian. Originally railway electrification was regarded as an urban proposition, to eliminate the smoke nuisance and facilitate rapid suburban service. The decision of the Chicago, Milwaukee & St. Paul Railway to electrify a long mountain division in Montana marked the acceptance of electric power as a means of economizing in the movement of tonnage freight up heavy grades in rugged country. The Norfolk & Western electrification takes still another step, the primary purpose of the improvement, which covers a short mountain section, being to expedite the collecting of coal cars from mine sidings all along the route and transporting them up steep grades to the classification yards at Bluefield. The steam locomotive remains in service on the division for the hauling of heavy through freight and passenger trains, but the second and third helper engines heretofore required are replaced by single electric locomotives. Several innovations have been introduced in the Norfolk & Western work, the chief of which are the use of single-phase, three-phase locomotives which take single-phase power from the overhead trolley system and convert it to three-phase power for the induction motors, and a catenary system carefully designed and adapted to curves as sharp as 12 deg.



TWO-UNIT ELECTRIC LOCOMOTIVES HAVE TOTAL WEIGHT OF 270 TONS

The electrified section, known as the Elkhorn grade, is located on the main line in the southern part of West Virginia, about 105 miles west of Roanoke, and extends from Bluefield to Vivian, a distance of about 30 miles. The section is double-tracked throughout, except in the Elkhorn tunnel, which is single-track, and is 3000 ft. long. There is also a large amount of third track, passing sidings, yard trackage and branches into the coal workings. The grades are heavy, running as high as 2 per cent on the 15-mile climb from Vivian to Elkhorn tunnel. Fully 60 per cent of the line is on curves.

New Use for Electric Service

As previously stated, the electrification of this section is primarily for the purpose of assembling from the mines, sidings and yards in the coal fields the entire eastbound coal tonnage and transporting it up the grade and over the summit to the classification yard at Bluefield, the division point of the railway. From Bluefield, after classification, it is shipped east to the various destination points, chiefly to the company's tidewater terminal at Lamberts Point, near Norfolk. All of the company's coal traffic originates west of Bluefield, and while much of it goes west, the easterly shipments are very heavy and constitute the chief loads handled electrically. Throughout the coal fields there are numerous colliery sidings, and the electric service includes the collection of loaded cars or trains from these sidings on the eastbound trip and the delivery of empties on the return trip. Thus the electrified section is practically a local switching and short-haul division between the coal fields and Bluefield, operated to a large extent independently of the other traffic on the main division. In addition to this heavy coal tonnage there is the through merchandise freight and passenger traffic over the division, which is still handled by steam road engines, assisted by electric engines used as pushers.

The trains can be despatched at fairly uniform intervals throughout the day, and thus desirable loading conditions on the power system are obtained and at the same time the full service is handled with a moderate number of locomotives, each making a number of round trips per day. The electrification materially reduces the time required to handle trains and provides a more economical and efficient service over the heavy grades. The heavy freight trains are handled at running speeds up the grade of 14 miles per hour as compared with about 7½ miles per hour under the old steam operation, and a further saving in time is effected by the elimination of the delays formerly occasioned by trains occupying the track, while engines took on coal and water, one at a time, at the several coal and water stations on the grade.

The tonnage coal trains weigh 3250 tons and were formerly handled by three steam locomotives; two of these, a road engine and a helper, one at each end of the train, were used over the entire section, and a third, at the rear, served as a pusher up the 1.5 and 2 per cent grades to the Elkhorn tunnel. The steam engines were of the heavy Mallet type. Under the electric operation a single road engine is used over the division and a second electric engine is used as a pusher up the heaviest grades. One electric locomotive thus takes the place of two Mallets, and handles the train at approximately double the steam speed. On 0.4 per cent grades the speed of the electric locomotives is 28 miles per hour.

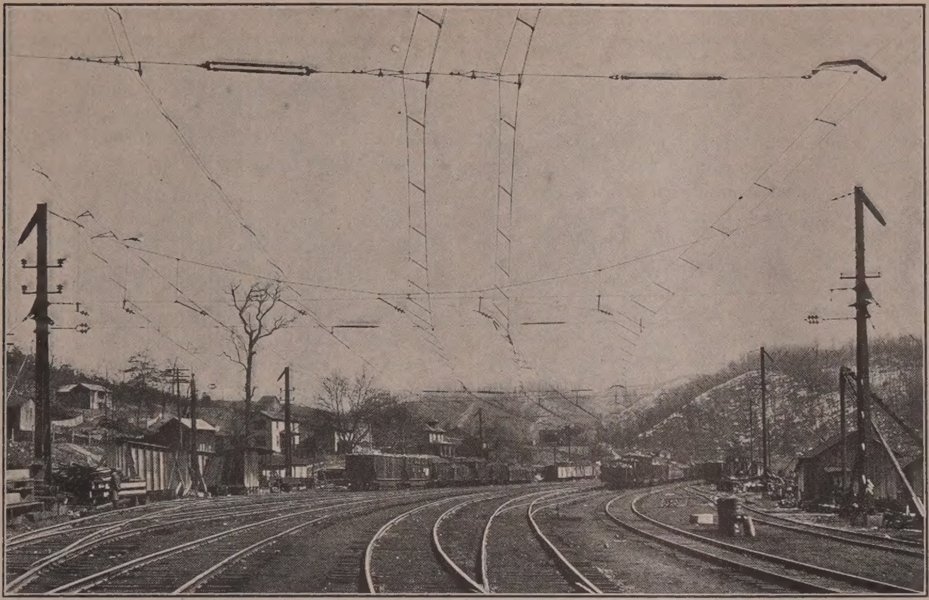
SINGLE-PHASE THREE-PHASE POWER

The electrical installation has been laid out and the power plant, locomotives and other equipment have been provided for handling twenty tonnage trains, or 65,000 tons per day eastbound, and ample provision has been made for additional traffic and extension when required. At present about twelve of these tonnage trains are handled.

Power is generated, transmitted and distributed single-phase at 25 cycles and collected from the overhead catenary trolley contact system at 11,000 volts. By means of the phase converters, which, in connection with the main stepdown transformers on the locomotives, transform the single-phase power of the trolley to three-phase power for use in the induction motors, the advantages of high-voltage single-phase distribution and three-phase induction motors for heavy mountain tractions are both secured. The system also permits electric braking, which holds trains at constant speed on descending grades, and returns energy to the line.

LOCOMOTIVES

Twelve 270-ton Baldwin-Westinghouse locomotives, each consisting of two 135-ton units or halves, with an articulated connection, handle the traffic. The complete locomotive is 105 ft. 8 in. long over all, and has a driving-wheel base of 83 ft. 10 in. The overall width is 11 ft. 6¼ in., the height to the top of is 14 ft. 9 in., and the height to locked pantagraph, 16 ft. The driving



IN YARDS CROSS-CATENARY SYSTEMS CARRY THE LONGITUDINAL WIRES

wheels are 62 in. in diameter. The weight on drivers is 220 tons. The locomotives are designed for the two speeds, 14 and 28 miles per hour. The maximum guaranteed accelerating tractive effort for a locomotive on heavy grade is 133,000 lb. The approximate maximum guaranteed horsepower developed by the motors is 5000 on heavy grades and 6700 on 0.4 per cent grades. On tests and in service the locomotives have developed a drawbar pull considerably in excess of the guaranteed maximum, the highest record with the dynamometer car being 180,000 lb.

The power station is located at Bluestone, about 11 miles west of Bluefield, mainly for the reason that this is almost the only available source of water for boiler feed and condensing purposes in the district. The power station is of the usual type, using steam boilers and steam turbines as the prime movers. The station has an installed capacity of 30,000 kw. High tension power is transmitted at 44,000 volts, 25 cycles, single-phase. The wires are carried on the catenary supports except at the tunnels, where the line goes over ground over the summit. There are five transformer substations, having an aggregate installed capacity of 28,000 kva in 44,000/11,000-volt single-phase step-down transformers. Shops for the electric equipment have also been built at Bluestone.

CATENARY SYSTEM

Reliability of service and low cost of maintenance were the two main objectives in the design of the catenary line construction. An effort was made to secure the maximum degree of flexibility and freedom from hard spots at the contact wires so as to avoid rapid deterioration and frequent breakings and failures, and a special effort was also made to provide the highest type of installation so as to avoid interruptions to service due to installation breakdowns. In designing the supporting structures an effort was made to secure a neat and attractive appearing structure that would not interfere with the view of signals and would present the least surface for corrosion and minimize the cost of painting and repairs as well as the first cost of installation. The system has therefore taken the form of a single catenary with an auxiliary messenger wire above the trolley, one main hanger being provided for every two intermediate connections between auxiliaries and trolleys on tangents. On curves the angularity of the hangers provided the necessary flexibility, the auxiliary messenger and trolley wire being connected to the hanger at the same point.

The principle of providing more than one insulator between live parts and ground has been adopted, and suspension insulators are used throughout as being the least liable to fail due to transverse stresses. Care has also been taken to guard against failure due to unequal expansion and contraction resulting from temperature changes. For the main line tracks three suspension insulators are connected in series so that the failure of one or even two at any point will not result in the complete breakdown of the insulation and interrupt the service. For the yard tracks and siding two such insulators are used.

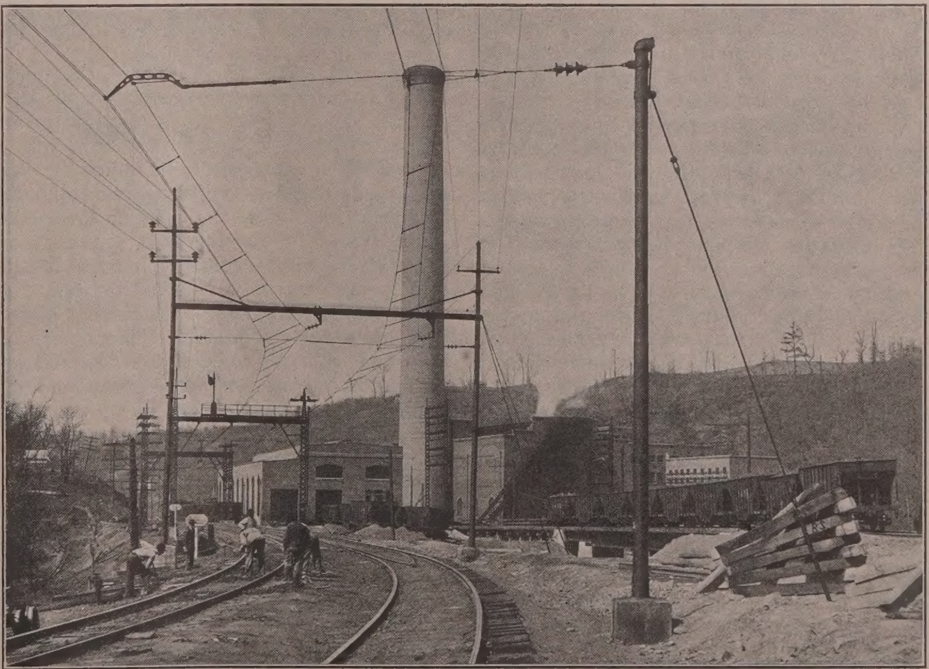
SUPPORTING STRUCTURES

The line supports are light bridges made of tubular poles and Bethlehem H-section cross beams, and the structures are guyed on the outside of curves to resist the curve pull by means of two heavy guy rods secured in concrete anchorages. At signal bridges the signals and catenary system are supported on structural bridges which consist of latticed posts carrying shallow plate girders which form as little obstruction to the view of signals as possible and are easily painted and maintained. The same type of bridge is used on curves where it is impossible to provide guides at the outside of the curve. In yards, as shown in one of the illustrations, an overhead cross catenary cable is used to support the longitudinal catenary wires of a large number of tracks.

Nominally the catenary supporting structures are 300 ft. apart on tangent tracks and somewhat closer together on curves, depending on the degree of curvature and whether or not intermediate "pull-off" poles are used between adjacent supporting structures. After the theoretically desirable locations for structures are determined, many adjustments and compromises in locations have to be made on account of existing structures, station platforms, property, bridges and signals.

CONDITIONS MET IN OVERHEAD SYSTEM

In this installation it was necessary to hold a trolley wire at a uniform height of 24 ft. above the top of the rails in such a location that it would not vary horizontally more than 12 in. from the center of the rails, and that the bottom of the wire would present an unbroken level surface on which the pantagraph shoe would ride smoothly. With the structure supported only every 200 or 300 ft. the temperature ranging from 110 to minus 10 deg. Fahr. will change the stresses from almost zero to close to the elastic limit, and in addi-



THREE PREVAILING TYPES OF CATENARY SUPPORT ON MAIN TRACK

In the middle ground the light frame most used; in the background several heavier frames carrying signals as well as the catenary system; in the foreground a pull-off pole. Note the inclination and warping of the system.

tion to this wind and sleet loads must be reckoned with, the system must be insulated for a potential of 11,000 volts to ground under all atmospheric conditions, and the wires over one track must be insulated from the wires over all other tracks.

ARRANGEMENT ON TANGENTS

Over tangent tracks a steel casting attached to the horizontal member of the supporting structure supports three insulators, each good for a working voltage of 11,000 volts. To the bottom insulator is attached a malleable iron casting which supports and clamps the messenger wire. This has ample bearing for the wire and has arcing horns so that should an insulator fail the arc would probably be from the casting instead of from the wire. The messenger wire is ½-in. galvanized steel stranded cable with a breaking value exceeding 30,000 lb. Its nominal sag is 5 ft. in a 300-ft. span. At 30-ft. intervals along this wire are bent clips which hold the hanger straps. These straps vary in length according to their position on the messenger, and at the bottoms are trolley clips which, however, on tangent track do not grip the contact wire, but hold an auxiliary messenger wire. From the auxiliary messenger wire the trolley wire is supported by clips placed 15 ft. apart, so located that they are equal distances from the hangers.

WARPED SYSTEM ON CURVES

Where the track is curved, as in the largest part of the work, the trolley wire must also be curved so that it approximates the track curvature. The system has been designed within such limits that the contact wire may be 12 in. off the center line of track in one direction at the bridges or points of support, and 6 in. off the center line of track in the other direction at the center of the span. This allows the trolley curvature to be less than the track curvature. In this connection account must be taken of the superelevation of the outer rail of the curve, which throws the center of the pantagraph in so that the curve which the trolley must approximate is not vertically over the center of the track, and must be carefully calculated.

On such curved track the catenary system, instead of lying in a vertical plane as over tangent track, lies in an inclined plane which is warped until the trolley curvature approaches the track curvature. The insulators respond to the curve over the system and hang at a definite angle depending on the curvature. The hangers on curves are 15 ft. apart and the clips at the bottom hold both the auxiliary messenger and the contact or trolley wire. This is essential, since unless held vertically below the auxiliary messenger the curve pull of the contact wire would draw it up to the same level as the auxiliary messenger. This holding of both wires by the same clips at the end of the hangers does not, however, result in hard spots in the trolley. Since all hangers lie at an angle to the horizontal and the whole system is sufficiently free to move vertically, under the slight upward pressure of the pantagraph, smooth riding is insured.

The amount of trolley curvature that can be obtained with a fixed distance between points of support, that is, for a definite span, is limited by the practical length of hangers and by the amount the point of attachment of insulators on the bridge can be offset from the center line of the track.

PULL-OFF POLES

In order to avoid an uneconomically close spacing of structures on the high track curves one and sometimes two pull-off poles are used between bridges. These pull-off poles are single tubular steel poles set in concrete foundations and having single guys of the same type as used on the catenary bridges. A wire strand from the top of these poles and insulated from it by three insulators is fastened to both messenger and contact wire and serves to bend the plane of the catenary system. The use of such poles and a similar pulling off or bending of the plane of the catenary by means of pull-off strands at the bridges permits a much greater distance between points of support than would otherwise be the case.

One of the illustrations shows plainly the standard light support for ordinary main-line use in the middle ground, a heavier support of structural steel for carrying signals as well as the catenary system in the background, and a pull-off pole in the foreground.

In the yards, as previously stated, cross catenary systems replace the steel bridges. Two instead of three insulators are used between live wires and grounded structures, and the auxiliary messenger wire is omitted, this giving a smooth enough contact for speeds of 14 miles per hour or less.

In the Elkhorn tunnel, which is single-tracked, 3000 ft. long, and only 14 ft. wide at the springing line and 19 ft. 3 in. high at the top of the arch, special construction was necessary. After extended experiments in insulators and arrangements of same a system was adopted which has performed satisfactorily.

The layout and design of the entire installation was worked out by Gibbs & Hill, engineers for the company. All construction work except the power house and section buildings and some of the power-station equipment was carried out by a specially organized railroad force under the supervision of the engineers.

A Cement Pipe Joint

JOINTS in concrete pipe made by the Lock Joint Pipe Company and used under pressure are sealed by placing over the joint a 3/16-in. mortar coat troweled on hard after the 1:1 cement mortar of the joint proper has been allowed to set. The final coat is neat, made with cement sifted through a 200-mesh sieve. The theory of this final mortar coat is that the larger volume of cement mortar in the main joint will contract on setting and pull away from one of the two ends of the pipe which it connects, thus allowing a passageway for water under pressure. When the "secondary joint," as it is termed, is applied this fine crack is sealed. In order that the inside of the pipe may be smooth a recess 3/16-in. deep is left in the ends of the pipe at the inside surface. The method, which has been patented by the company, has been used, without leakage, on test pipe carrying a pressure of 95 lb. to the square inch. On the Sooke Lake pipe line for Victoria, B. C. (described in the Engineering Record Feb. 21, 1914, page 226), one of the first inverted siphons tested showed large leakage under a head as low as 15 ft. It was discovered that, contrary to instructions, unsifted cement had been used. The secondary-joint coats were ordered cut out and replaced with sifted cement. No serious leakage thereafter developed, though the maximum head is 93 ft.

Architects Must Be Registered in New York

Law, However, Does not Contain Any Express Provision Discriminating Against Structural Engineers, as in Illinois

ARCHITECTS practising in New York State must now be registered, the last Legislature having passed a registration law which has been approved by the Governor. The statute, however, does not contain any definition or express provision which would discriminate against structural engineers, as does the Illinois law. The question whether a structural engineer who designs, say, a power house, would be practising architecture, might come up, for the law covers the "practice of architecture." If those entrusted with the enforcement of the law should decide that the design of such a structure involves the "practice of architecture," the same situation that has become so acute in Illinois might be found in New York State.

PROVISIONS OF LAW

Under the new statute those engaged in the practice of architecture "under the title of architect" before the law took effect may secure a certificate by presenting satisfactory evidence to the board of examiners and paying the required fee. The applicant, however, must have been engaged in practice for two years prior to the date when the law took effect, or, if in practice on his own account or as a member of a reputable firm, one year.

The board of examiners is to be composed of five architects who have been in active practice in the State of New York for not less than ten years. The members of the board will be appointed by the regents of the University of the State of New York.

QUALIFICATIONS

Applicants must be 21 years of age and of good moral character. They must have completed satisfactorily such courses in mathematics, history and one modern language as are included in the first two years in an approved institution conferring the degree of bachelor of arts. In addition they must have had at least five years' practicable experience. Those, however, who have been graduated from a recognized architectural college or school need have but three years' practical experience.

Architects from States having standards of qualifications for registration at least equal to those of New York State may be registered in New York without examination.

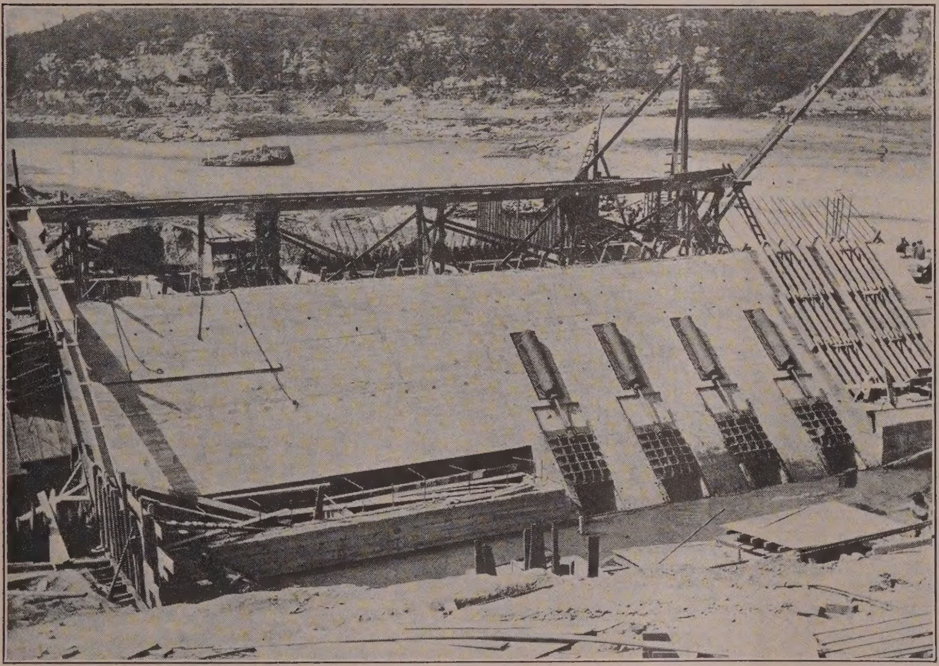
The fee for examination or certificate of registration is to be $25. Copy of the certificate must be filed with the clerk of the county in which the registered architect resides or maintains a place of business.

Violation of the article is punishable for the first offence by a fine of not less than $50 and not more than $100, and for a subsequent offence by a fine of not less than $200 or more than $500 or imprisonment for not more than one year, or both.

Reinforced-Concrete Structure at Austin, Texas, Replaces Dam Which Failed

Part II—Which Describes the Departures from Customary Hollow-Dam Design, and the Crest and Sluice Gates

THE total length of dam and corewall is 1535 ft., of which 1091 ft. is spillway, 124 ft. bulkheads, and 300 ft. corewall. A typical section of the new portion of the dam is shown on page 708. At a point about 2½ ft. above low water level, the back slope ends, intersecting a narrow horizontal bench. The object of the bench is to allow flow of water through any completed section of the dam during construction, the flat horizontal slab, which runs the entire length of the dam, being omitted until the completion of the work. During construction the total flow of the river was normally taken through the sluice gates in the bottom of the dam, but in the case of floods the openings through the horizontal bench, together with the area afforded by the sluice gates, would usually take care of the whole river flow without an elevation in the water level of more than 4 to 6 ft.



OPERATING CYLINDERS OF SLUICE GATES ARE ALWAYS SUBMERGED

The supporting walls are both longitudinal and transverse. The longitudinal walls are inclined, so that they form an angle of nearly 90 deg. with the upstream deck. The slope is such that the resultant of the forces which they resist, made up of the water pressure acting against the surface of the deck and the gravity component of the deck and the walls themselves, has the same direction as that of the longitudinal walls.

REDUCING WIDTH OF DAM

Owing to the difficult character of the foundation, as has previously been stated, it was desirable to make the distance through the bottom of the dam, measured from upstream to downstream side, as short as possible. In the usual form of design the inclined deck goes up to the elevation of the crest of the dam, where it joins with the spillway. The form of the spillway is determined by the application of the ordinary parabolic formula, and this gives a certain distance, measured horizontally, from the crest of the spillway down to its toe. As shown in the typical section, the spillway was designed in accordance with the usual method, and the sloping deck made to intersect it at some 25 ft. further downstream and 6 ft. lower vertically than in the customary design. By this method a proper length of theoretically designed spillway was made available, as well as an inclined deck of substantially the total height up to the spillway, and, at the same time, the length through the dam from front to back was reduced about 25 ft., diminishing in like proportion the length of the transverse walls, the length of each transverse wall foundation, and eliminating one longitudinal wall. While the saving in material and labor, due to this form of design for a given factor of safety, was greatly reduced by the adoption of this design, the cost of the form work was increased so that the net saving effected, though considerable, was not so great as would at first appear.

All the concrete used for making the deck and cutoff wall was rendered waterproof by an admixture of hydrated lime, in the proportion of 8 to 10 per cent (by weight) of the cement, the proportion being varied with variations in the voids in the aggregate. This has proved to be thoroughly satisfactory, as were also the tests made prior to its adoption.

EXPANSION JOINTS

An ample number of expansion joints (at every fifth panel) is provided. The expansion panels have both the upstream deck and the spillway entirely separated from the adjacent portions of deck and spillway on either side. The joint is made of a ½ x 8-in. Ingot-iron plate. One-half the width of the strip, 4 in., is cast into the concrete of the abutting edge of a standard panel. The end of the slab, together with the projecting iron, is painted over with a heavy coat of asphalt. The expansion panel is then cast so that its edge abuts against the edge of the slab of the standard panel.

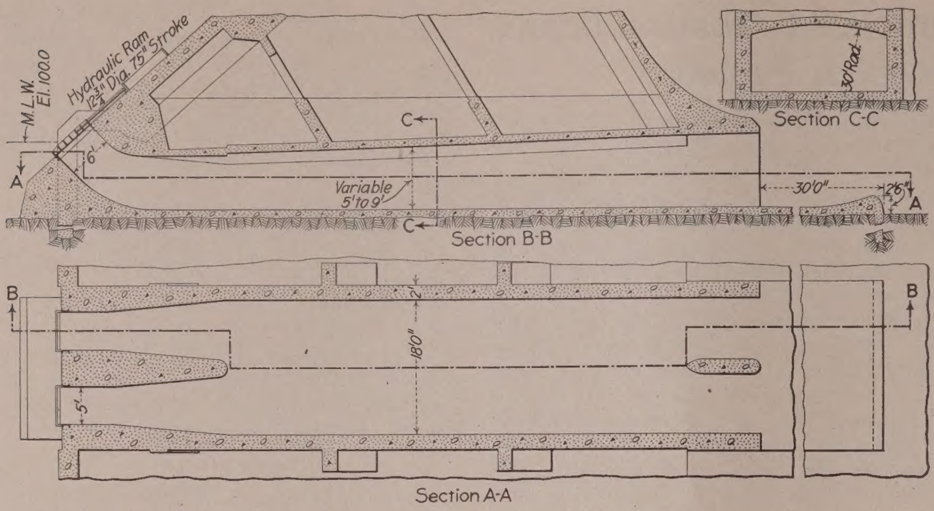
Since its construction the dam has been subjected to temperatures varying from 32 to 90 deg., and these expansion joints have proved thoroughly satisfactory. Before construction was quite completed and when the whole of the dam was still exposed to the sun and atmospheric conditions, it was possible to see the space between the abutting ends of the panels at expansion joints change more than ¼ in. in a few hours.

CREST GATES

The crest gates, 15 ft. high on the concrete section, are made with a structural-steel framework; the lower portion is filled with concrete, while the upper part is covered with creosoted yellow pine. The thickness of the gate is 1 ft. There are twenty-eight large gates and twenty-six small ones, making a total of 1091 ft. of spillway. These gates turn about rockers or bascules, which are fastened into the piers at either end of the gate. The large gates, which are placed on the low section of the dam, have, in addition, a middle bascule to support the middle and take the heavy water pressure, due to the great size of the individual gates. These large gates are, of course, continuous from pier to pier, and the middle bascule is placed on a low pier built entirely in the rear of the gate, the bascule projecting forward so that a portion of the rear surface of the gate rests against it. When the gates are vertical and the water is at normal height, the center of pressure coincides in elevation with the point of support on the bascule curve. When the water rises above the normal level, the center of pressure likewise rises, and there then exists a net moment to cause the gate to overturn. As overturning begins, the moment to cause it increases, due to the diminution in pressure on the lower part. This increase in overturning moment is compensated for by the fact that the gate turning around the bascule is continuously changing its point of support, this point moving from a position at one-third the height of the gate to one very near the middle of the gate when it is, finally, in a horizontal position. In order to prevent the gates from leaving the bascules and being pushed downstream, guide pins are placed at either end of the gate, which pins operate in curved channels of cast iron, set into the concrete faces of the piers. In the case of the large gates, the water reaches an elevation of 65 ft. 9 in. before overturning takes place. The bottom of the gate, when horizontal, is 5 ft. 4 in. above the crest.

The small gates, which are 6 ft. in height, overturn when the depth of water is 85 ft. 4 in., or when the water is 5 ft. 4 in. in depth over the crest. These small gates, therefore, overturn before the large ones do, and, usually, the operation of the small gates gives more than ample discharge over the spillway to take care of normal river flow. Only in case of flood will the large gates open.

When the level of the water in the lake sinks sufficiently, these gates automatically close. This is effected by the counterweighting provided by the concrete filling



EIGHT SLUICE GATES LEADING TO FOUR CHANNELS ARE PROVIDED IN DAM

in the bottom of the gates, so that the center of gravity of the gates is near the bottom, and there is a continual tendency for gravity to restore them to their normal, vertical position. The small gates close when the water has sunk to 63 ft. 10 in., or when the level of the lake has dropped some 14 in. below normal. The large gates close at a water elevation of 64 ft. 8 in., or when the level of the lake has fallen to 4 in. below normal.

OPERATION

These gates have not only operated in a thoroughly satisfactory manner, but have passed one heavy flood, together with some fifty or sixty acres of driftwood that came down the river and accumulated in the lake prior to the full opening of the gates. In this latter respect their performance is remarkable. When one of the large gates opens and 14 ft. of water begins to pass over the crest, the volume and velocity of discharge carry large trees through the space between the piers and over the upper surface of the gates. When the spread of the branches is greater than the openings between the piers, the force of the water breaks off the limbs and carries the broken trees through without difficulty.

With the use of these gates the lake level undergoes no substantial change between the lowest and highest river stages, the minimum level being about 14 in. below normal and the maximum for heavy floods not more than 34 in. above normal.

SLUICE GATES

There are eight sluice gates, set in pairs, each discharging into its own tunnel, the two then merging into one. The gates are each 5 x 6 ft. in size and are operated by pistons, the working fluid being oil under a pressure of 750 lb. per square inch. The cylinders are 12¾ in. in inside diameter and the pistons have a 78-in. stroke.

The main discharge channel is 18 ft. wide and approximately 14 ft. high. The total area is 250 sq. ft., while the area of the openings of the two sluice gates is only 30 sq. ft. each, or 60 ft. for the two. The velocity through the sluice gates will be about 60 ft. per second, while the velocity through the main channel will be less than 15 ft. per second.

It is to be noted that the cylinders are placed on the deck of the dam instead of inside, as is customary. In this way the cylinders could be placed much nearer the sluice gates than if they were inside the dam, and the sluice gates outside. This shortens the piston rod, and thus a smaller rod may be used. This means that the size of the cylinder may be somewhat reduced. Furthermore, the saving in concrete and form work amounted to some $5000. Moreover, not having any inset made in it, the dam is stronger than it would otherwise be.

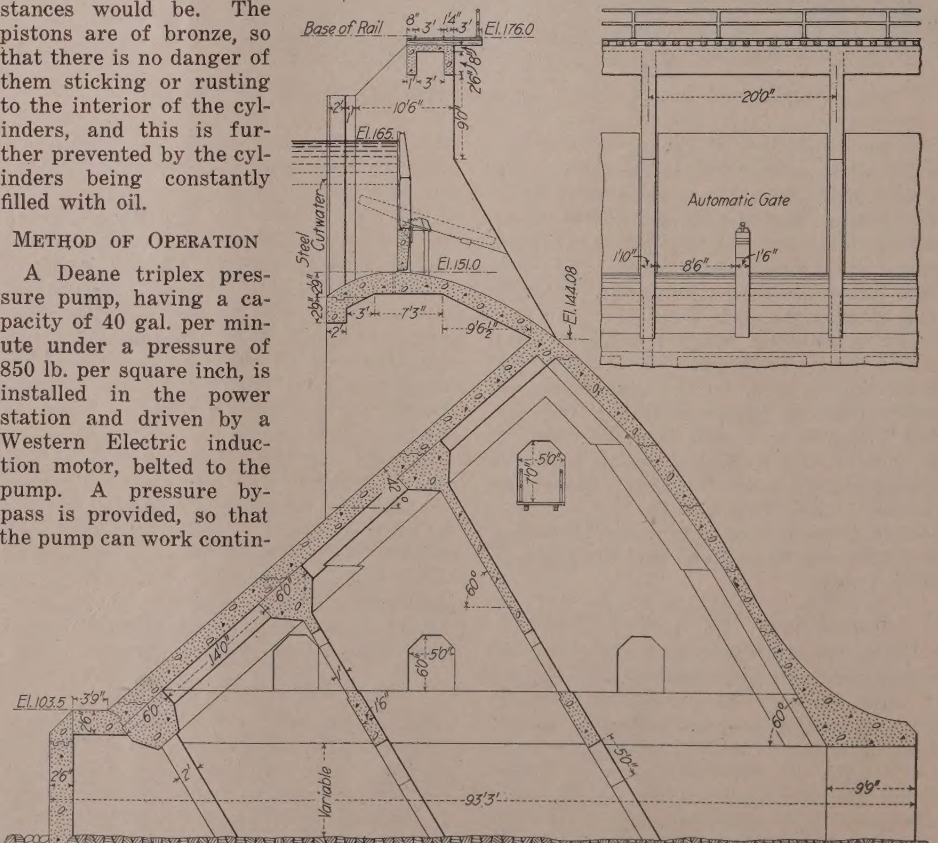
This method of installation has the apparent objection that the cylinders cannot be inspected or repaired, as they are normally under 60 ft. of water. This objection, the designers feel, is an academic one. The extent of operation of these gates will never be sufficient, in many years, for the element of wear to have any bearing on the subject. An ordinary Corliss engine, in two hours, will make more strokes than these cylinders will in fifty years. Metallic packing is provided so that it is permanent and not subject to deterioration with time, as most organic substances would be. The pistons are of bronze, so that there is no danger of them sticking or rusting to the interior of the cylinders, and this is further prevented by the cylinders being constantly filled with oil.

METHOD OF OPERATION

A Deane triplex pressure pump, having a capacity of 40 gal. per minute under a pressure of 850 lb. per square inch, is installed in the power station and driven by a Western Electric induction motor, belted to the pump. A pressure bypass is provided, so that the pump can work continuously when the gates are being operated. Any excess pumpage will pass from the discharge to the suction pipe, the bypass valve between the two opening when the predetermined pressure for which it is set has been reached. The high-pressure service pipe and the low-pressure pipe for return of oil to the suction side of the pump run from the power house into the dam and pass along the side of the walkway through the dam, these two pipes forming two of the three railings on one side of the walkway. At each of the branch pipe connections to the gate cylinders is placed a specially designed high-pressure four-way valve, and the movement of the valve admits the oil, under pressure, to one end or the other of the operating cylinder it controls, thereby opening or closing the gate.

In order to determine the position of the gates an indicator is provided on each. It consists of a section of ⅜-in. copper wire cable attached to the gate, passing a short distance up the deck, then through a 1-in. pipe in the deck into the inside of the dam. A stuffing box is provided, so that there is no leakage. On the inside end of the cable is hung a weight of concrete of about 75 lb. Adjacent to the vertical path of the weight is placed a gage having the gate positions marked on it.

The gates themselves are heavy slabs of cast iron, about 1½ in. thick, 5 ft. 8 in. wide by 6 ft. 8 in. long. Heavy ribs are cast at intervals on the outer surface of this gate, tapering from 4 in. high at the end to 7½ in. high at the middle, the thickness of the ribs being 1½ in. The spacing of the ribs is 12 in. Each gate slides on a heavy, cast-iron frame, set into the concrete. The upper side of the gate frame and the under face of the gate are both lined with bronze strips 2 in. wide by ⅜ in. thick. These gates have been operated a number of times under varying depths



SPECIAL DESIGN OF CREST USED TO SHORTEN WIDTH OF DAM of water and have proved satisfactory. The gates and frames were built by the Alamo Iron Works, of San Antonio, Texas, while the cylinders with their pistons, and the four-way operating valves were made from special designs by the Tips Foundry & Machine Works, of Austin.

Part III, which will describe the hydroelectric plant, will be published in the next issue.

Recommend Filtering Chicago Water and Progressive Disposal of Sewage

George A. Soper, John D. Watson and A. J. Martin in Comprehensive Report Conclude Chicago Sanitary Policy Is in Arrested State of Development

THAT the means now followed by Chicago in getting rid of its sewage and protecting its drinking water are not satisfactory, and cannot be made so without radical changes of policy and procedure, is the opinion reached after a year's study of this problem by a board of experts and expressed in an exhaustive report to the Chicago Real Estate Board. The experts are Dr. George A. Soper, formerly president of the Metropolitan Sewerage Commission of New York; John D. Watson, chief engineer of the extensive sewage disposal works of Birmingham, England, and Major Arthur J. Martin, consulting engineer, of London, and the author of a standard book of reference on sewage.

It is declared by the experts to be wrong in principle and in practice to use the unpurified lake water for drinking purposes, to discharge the crude sewage and foul industrial wastes into the open waterways which flow through the city and to flush this filthy material into the Illinois valley.

In spite of the $64,000,000 which has been spent for the disposal of the sewage, the Chicago River is now in such a state as to give rise to serious nuisance in places, and the discharge of the filth through the Drainage Canal has made impossible a wholesome state of the Desplaines and Illinois Rivers for 100 miles from Chicago.

PEOPLE UNAWARE OF CONDITIONS

The experts found very few persons in Chicago, who seemed to be aware of the conditions in the naturally beautiful and populous Illinois valley, as shown by the inspections which they made and by the records of various other scientific investigators. By sending the filth which formerly stagnated in the Chicago River down into the valley, the nuisance-producing material has been transferred from one place to another, but it has not been disposed of in the sanitary sense. For many miles the river water is not fit to drink, nor to wash in, nor to water stock, nor for many other domestic, agricultural and industrial uses of a normal river. The water is discolored, malodorous, poisonous. Fish die in it; the thought of swimming in it is repugnant to the senses; boating, far from being a pleasant and healthful diversion, can be enjoyed only by the hardy.

Every conceivable kind of filthy thing that can be flushed away by water from the streets, houses and persons of the sick and well in a population of 2,500,000 persons, not to mention the excrement of a 100,000 head of horses, cattle, hogs and mules, is cast into the valley in the confident hope that the beneficent forces of nature will somehow dispose of them. And nature does dispose of them, but not without producing conditions which are probably unequalled. The foul condition of the water reaches its culmination at some point between Morris, 62 miles from Chicago, and the Marseilles Dam, 80 miles below, depending on the season, and consequently, the rate at which putrefactive decomposition occurs.

A study of the history of the present scheme of disposing of the sewage, and a careful examination of the law which provided for the construction of the Drainage and Ship Canal, have convinced the experts that the intention of the State Legislature in passing the Sanitary District Act was to prevent many of the evils which now exist, and which must become greatly magnified with the increase of population, unless radical changes are made.

CANNOT BE RIVER AND SEWER EFFICIENTLY

The Sanitary and Ship Canal, if properly used, is capable of aiding in solving the double problem of sewage disposal and water supply, and will provide an important link in the water highway from Lake Michigan to the Mississippi, but it cannot, unaided, perform all the functions which have been expected of it. The canal cannot properly serve both as a river and a sewer. At the present time it is used as a sewer—in the future it should be regarded as a river. All the waterways of Chicago, which at the present time are little else than open sewers, should be redeemed and restored to their natural and appropriate uses.

After reviewing the topography, growth, civic character, population, government and wealth of the city, the experts say in their report that they were "unable to find anything in the situation of Chicago, as regards drainage, or the sociological condition of the inhabitants which warrants the adoption of lower sanitary standards than are suitable for the most enlightened communities," and that to attain to these standards the city "needs works of main drainage and sewage disposal such as other great centers of population have found it necessary to construct."

Intercepting sewers are recommended to take the sewage from the present collecting sewers and convey it to suitable points for disposal, and treatment works in order to fit the sewage for discharge into the Chicago River or Drainage and Ship Canal, according to the opportunities which can be afforded for carrying the liquid residue away.

REMOVE SOLIDS AS MINIMUM DISPOSAL

Solids which are capable of floating or depositing should be removed from the sewage and as much more improvement effected as can reasonably be accomplished. The removal of the larger solids is a minimum requirement, and will serve as a beginning for a part of the sewage. For the rest, some form of oxidizing treatment, such as the experience of other cities has shown to be practicable, should be adopted. Only that portion of the sewage which the water can carry away and absorb without offense should be emptied into the waterways.

In order to accomplish the results desired, there should be one main disposal plant located to the west of the city, and various smaller installations elsewhere. The smaller installations would consist chiefly of screening and settling devices; the main plant would provide for more thorough treatment. The works should be capable of extension and development, as the conditions of the future require.

PREPARE GENERAL PLANS NOW

General plans for the collection of the sewage can, and should be, prepared long in advance of the actual needs of construction, and if this is done in accordance with the best technical practice of the day, there will be provided a definite program of construction toward which all future sewer building can be made tributary. The cost, being anticipated, can be provided for and so distributed as not to prove too serious a burden.

WATER NOW UNSAFE

The water supply should be protected against such pollution as the immense population of Chicago and vicinity, and the extensive commerce upon Lake Michigan render unavoidable. The water is now at times turbid, polluted and unsafe for drinking purposes. The experts recommend that it be filtered.

With regard to the carrying out of their recommendations, the experts say in their report: "We recommend that steps be at once taken to prepare a general plan and policy of sewage disposal which will give to the water supply all the protection which it is practicable to give and get rid of the sewage without unnecessary danger or offense."

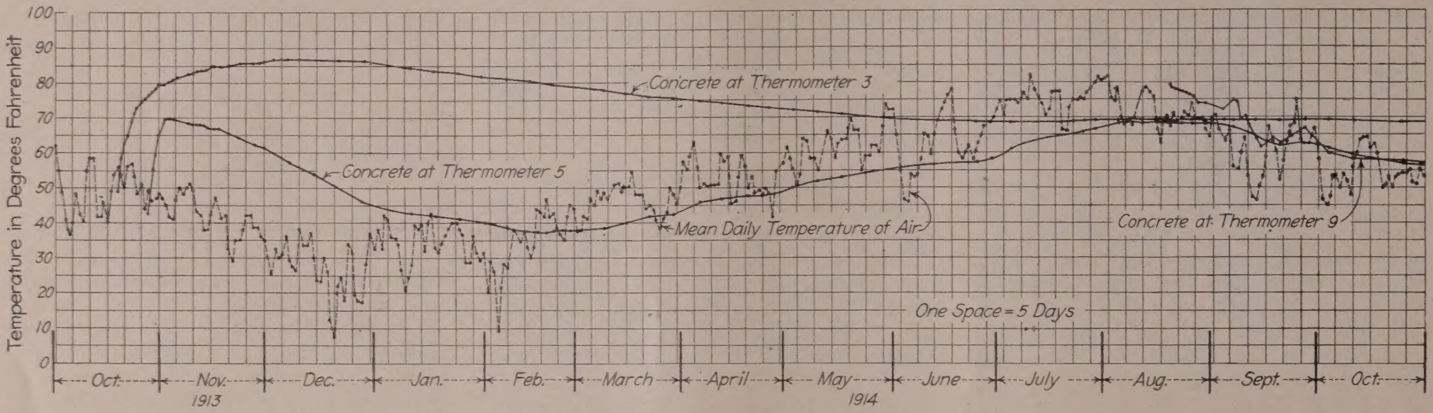
Cement Prices at Constantinople

PORTLAND cement is now quoted at $1.76 in Constantinople, and this promises to be a fertile field for cement manufacturers when the present war is over. The greater part of the cement available in this district is furnished by two factories located in the suburbs of Constantinople, whose combined yearly output is from 450,000 to 500,000 sacks, all of which is at present being taken by the military authorities. The quality of this product varies but is always poor, there being no uniformity as to either hardness or color. This native cement commands, in normal times, approximately 50 cents per sack. The introduction of well-known German and Belgian brands of cement has been attempted from time to time, but has not been very successful. Their use has been limited to the very best class of work, due chiefly to their cost, which in normal times is about 75 cents per sack. The point that should be of particular interest to the American exporter is that with the close of the war building construction is almost certain to be begun on a large scale in this part of the world. The dilapidated wooden and brick houses, of which a considerable section of Constantinople is composed, must shortly be replaced by substantial buildings requiring a quantity and a quality of cement that the present local factories cannot supply.

Temperature Changes in Mass Concrete Found to Be Relatively Small

Electric-Resistance Thermometers in Arrowrock Dam Record Seasonal Variations of 30 Degrees and Daily Variations of 1 or 2 Degrees

MASS CONCRETE shows relatively small daily and seasonal variations in temperature at distances of one foot and over from the face of the structure, according to the results of tests made at the Arrowrock Dam. The effect of chemical action during the setting of the cement in the summer season results in a temperature of 90 to 95 deg. within a period of about 30 days. These conclusions, among others, are reached by Charles H. Paul, construction engineer, and A. B. Mayhew, principal engineering assistant on the Arrowrock Dam, in a paper entitled "Temperature Changes in Mass Concrete" published in the "Proceedings" for April, page 789, and presented May 5th before the American Society of Civil Engineers. The salient features and final conclusions in full are here abstracted.



TEMPERATURE VARIATIONS IN MASS CONCRETE OF ARROWROCK DAM AT THREE DIFFERENT DISTANCES FROM FACE

Thermometer 9 is 1 ft. from the east face, thermometer 5, 3 ½ ft., and thermometer 3 is 20 ft. from the west face.

PLACING THE RESISTANCE THERMOMETERS

Nine resistance thermometers have been installed in the dam to date, and have been in place for periods ranging from about 3 to about 19 months. Although some of the experiments have been in progress for more than a year, the greater part of the result is still affected by the high temperatures produced by chemical action while the cement is setting. It will probably be several years before a complete study can be made of the temperature changes.

The resistance bulbs were placed at various elevations and at different distances from the exposed faces of the dam. Ultimately, there will be one resistance bulb near the top of the dam, one about half-way between the original river level and the bed rock foundation, and eight more at intermediate elevations. When each resistance bulb was placed in the masonry, the lead covered cables were encased in ½-in. steel tubing and carried to an inspection gallery in the body of the dam, where the switchboard and indicator were installed. When the concrete in the dam was built to the approximate elevation at which it was desired to place a resistance bulb, concreting in that immediate vicinity was usually discontinued temporarily, and the concrete was allowed to set for a few hours. The bulb and conduit were then embedded in a trench, about 6 in. deep, excavated in the concrete, great care being taken to provide a soft, uniform bed for the bulb, and to cover it carefully. The distance of the temperature bulbs from the face of the dam varies from 1 ft. to over 76 ft.

TEMPERATURE VARIATIONS

The accompanying diagram for temperature variations of the concrete at three typical locations (1 ft., 3½ ft. and 20 ft. from the face) shows the large differences between the temperature of the concrete and that of the outside air, the rise of temperature due to chemical action, and the seasonal variations (at thermometer 5) after the effect of chemical heat is dissipated. On Oct. 19, 1913, thermometer 3 was placed 20 ft. from the west face on concrete poured two hours earlier, and within two days about 4 ft. of concrete was poured above it. On Oct. 29, 1913, thermometer 5 was placed 3½ ft. from the east face on concrete one day old, containing considerable steel reinforcement, and concrete was poured about 1 ft. thick above it. On Aug. 29, 1914, thermometer 9 was placed 1 ft. from the east face on concrete about twelve days old and concrete about 2 ft. thick was poured above it.

DISCUSSION OF RESULTS

The duration of the rise in temperature due primarily to chemical action, is undoubtedly largely dependent on the speed of placing, season of the year, consistency, brand of cement, and quantity of cement per cubic yard of masonry. From some incomplete results obtained by placing a mercury thermometer inside the forms of the regulating outlets, it was found that a temperature of 99 deg. was produced in about 24 hours by the chemical action caused by the setting of the 1:2 Portland cement mortar composing the lining of these outlets. It is evident from the diagram that the duration of this higher temperature was much shorter at thermometer 5 than at 3, possibly due, in part, to the greater distance of No. 3 from the base of the dam.

The results of daily variations, not given in this abstract, show conclusively that high or low temperatures of the air for short periods do not materially affect the temperature of the concrete 3 ft. or more from an exposed face, and that it takes some 4 or 5 days for the effect of continued high or low air temperature to appear in the temperature of the concrete at that distance from the face. The results obtained from thermometer 3 indicate that there is very little seasonal variation in the temperature of the concrete 20 ft. or more from an exposed face.

CONCLUSIONS

Among the conclusions already reached are the following:

1. Large bodies of concrete deposited rapidly during the summer season develop a temperature of from 90 to 95 deg. within a period of about 30 days, and maintain nearly that temperature for several months.

2. In the case of concrete 1 ft. from an exposed face, there is a daily variation in temperature of about 2 deg. when the daily variation in the temperature of the air is about 50 deg.

3. In the case of concrete 2 ft. from an exposed face, there is a daily variation of less than 1 deg. when the daily variation in the temperature of the air is about 50 deg.

4. In the case of concrete 3½ ft. from an exposed face, no daily variation in temperature is apparent when the daily variation in the temperature of the air is about 50 deg.

5. The seasonal variation in the temperature of concrete 3⅝ ft. from an exposed face is about 32 deg. when the seasonal variation in the mean daily temperature of the air is about 75 deg.

6. The experiments have not yet been carried far enough to show the seasonal variation at other distances from exposed faces, but it is probable that they become very much less as the distance from the face increases.

Most of the opinions here expressed seem, in the judgment of Messrs. Paul and Mayhew, to be warranted by the facts, but they realize that the effect of chemical action in the concrete, which is still going on, may not be fully understood, and that possibly later developments will show the need of modification of some of these conclusions.

SIXTEEN-FOOT LENGTHS of cast-iron pipe, instead of the usual 12-ft. lengths, have been used in Meridian, Miss., by M. L. Worrell. The saving in weight, handling, joint-making, etc., as reported at the recent convention of the American Waterworks Association was 78 cents a ton.

HYDRAULIC TEST OF SEWER PIPE, USING STEEL HEAD PLATES WITH RUBBER-TIRE GASKETS

Reinforced-Concrete Sewer Pipe Tested for Stiffness and Impermeability

A. T. Goldbeck, in Paper Presented Before American Concrete Institute, Gives Results of Experiments Made for City of Philadelphia

PHILADELPHIA is now beginning to use reinforced concrete for sewers of relatively small diameter. In order to dispel any doubt regarding its suitability for such uses A. T. Goldbeck, assistant engineer of the testing laboratory of the Bureau of Surveys, Philadelphia, made a series of tests which have been described in a paper presented before the American Concrete Institute entitled "Tests of Circular and Egg-Shaped Reinforced Concrete Sewer Pipe." The author concludes that carefully cured reinforced-concrete pipe is very satisfactory for sewer construction. The few tests of slag-concrete pipe indicated that concrete containing broken-slag aggregate is more impermeable than that made with broken stone, and also even slightly exceeds the latter in strength and stiffness.

SECTIONS, MATERIALS AND CONDITIONS OF CURING CONCRETE

Two kinds of pipe were made; one was circular in cross-section, 36 in. in diameter and 4 in. thick, and the other egg-shaped, having a long diameter of 36 in., a short diameter of 24 in., and a thickness of 3½ in. The egg-shaped section was provided with a flat base 8 in. wide.

The materials used were Portland cement which satisfactorily passed the standard tests, New Jersey bank sand and well-graded ¾-in. crushed trap rock. Four experimental sections were also made of concrete containing ¾-in. graded, air-cooled blast-furnace slag, having a weight of 74.7 lb. per cubic foot when shaken to refusal in a cubic-foot measure. The concrete was machine mixed in the approximate proportions 1:2:3½. All the pipe were reinforced with triangular mesh, of No. 6 gage for egg-shaped and No. 8 gage for the circular sections, placed 1¼ in. from the inner surface.

After being cast in special steel molds, the pipe were allowed to harden, some of them under atmospheric conditions, others subjected to a hot vapor bath continued for a period of about 12 hours. The application of hot vapor at a temperature of about 100 deg. Fahr. accelerates the hardening and permits the removal of the form the day after pouring without danger of injury to the pipe. It thus permits the manufacturer to economize on molds and likewise enables him to make pipe in freezing weather. After the molds were stripped, the green concrete was kept damp for one week by daily sprinkling.

METHODS OF LOADING AND BEDDING

The accompanying figure shows details of the test box for applying the load to the circular pipe; that used for the egg-shaped section was quite similar. Loads were applied, through damp sand in the box by a wooden plunger carrying a timber platform upon which bags of cement were piled. This method was adopted in the absence of a testing machine of the desired type and capacity, and was very expensive, though quite effective. The loads were applied at the rate of ten bags (950 lb.) in about five minutes, and vertical-distortion readings were taken after each ten-bag increment. In order to note the elastic behavior of the pipes under loads, distortions of the vertical diameter and in some cases distortions of the horizontal diameter were measured. This was done in two ways—by the use of an Ames dial reading to 0.001 in., and by the measurement of the middle ordinate between two light wooden battens swung into place between the crown and the invert.

Two methods of bedding the pipe were employed—in damp sand, and in a concrete cradle. Three inches of sand or concrete was used under the pipe, extending from each side to a height of one-quarter of the vertical diameter. Where a sand bedding was used, the pipe was placed on the layer of lightly tamped sand and sand was heaped and tamped around the sides to the proper height. In the case of the concrete-cradle bedding, the pipe was placed in the soft concrete and remained there until tested. In some cases the cradle was only one day old when the pipe was tested, but generally older. It was the aim to test a single pipe of each kind at the age of 7, 14, 21 and 28 days, bedded in sand and concrete and cured with and without steam, and this program was followed as completely as weather and other conditions would permit.

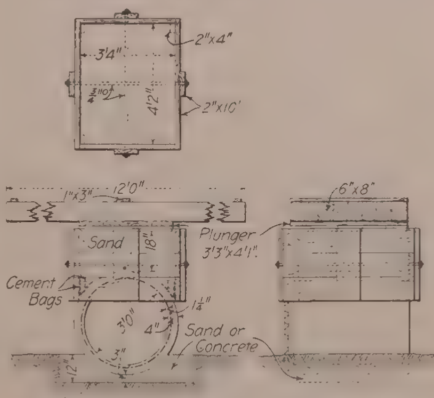
STIFFNESS AND APPEARANCE OF CRACKS

A typical load-distortion diagram is shown on page 712, the arrow-heads at various points on the curves indicating the load at which cracks were first noticed, and pointing toward their position on the section—top, side, etc. The pipe bedded in sand almost invariably failed by cracking at the bottom, although side cracks sometimes occurred. The circular pipe generally cracked first at the top inner face. Great increase in stiffness resulted from the use of the concrete cradle, cracks appearing much later than in those bedded in sand. It is recommended that whenever the external loading may possibly exceed 1000 lb. per square foot a concrete cradle be specified.

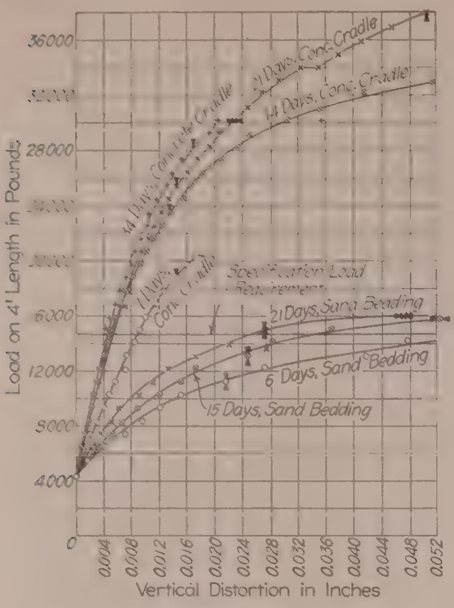
The steam-cured pipe, which have their setting accelerated, are more uncertain in strength at the later period. The strength of the normally cured pipe follows a fairly definite law of increase in stiffness with age. The steam-cured pipe, on the other hand, are extremely erratic, some of the older exhibiting less stiffness than those of lesser age. The steam method of initial curing is open to some question, and if allowed should be very carefully controlled in order not to drive out the moisture from the concrete before the cement has attained its set.

The behavior of the experimental pipe made with coarse aggregate of blast-furnace slag is interesting in indicating that the strength and stiffness of the pipes of this material equalled, or even slightly exceeded, those of pipe made with crushed-trap aggregate.

It is highly undesirable to subject a reinforced-concrete sewer pipe to a load so large that hair cracks are likely to form, because of the danger of corrosion of the reinforcing metal that must result. When a concrete cradle is used, the invert remains intact even long before the pipe has been loaded sufficiently to crack it at the crown. The sand-bedded pipes, however, cracked at the invert under quite a low load. This is an additional argument for the use of a



DETAILS OF TEST BOX FOR 36-INCH PIPE



LOAD-DISTORTION DIAGRAM FOR 36-INCH CIRCULAR PIPE

Note marked increase in stiffness resulting from use of concrete cradle.

concrete cradle rather than earth bedding. The fact that cracking occurs at the top or bottom on the inner surface before it occurs at the sides on the outer surface is significant. as it shows that the steel is correctly placed to provide for the tension at the dangerous sections of the pipe.

TESTS OF PERMEABILITY

In a sewer of the size tested, a leakage amounting to more than about 10,000 gal. per mile in 24 hours might well be regarded as the maximum allowable limit. A reasonably tight sewer placed in the wettest soil at a considerable depth should not admit more than this amount of ground water. Not only should the sewer be safe against excessive inward leakage, but it should likewise be capable of resisting a possible interior pressure due to flooding without cracking and thereby developing large leaks. The specifications required, therefore, that excessive leakage should not occur under an interior pressure of 5 lb. per square inch and that the pipe should not crack under a pressure of 10 lb.

The photograph on page 711 shows the manner of applying the hydraulic test to two sections of the pipe grouted together in the same manner as they would be treated in the trench. When tested, the grouted joints were two weeks and the pipe 30 days old. The results for stone concrete varied from about 8000 to nearly 16.000 gal. per mile per day, under an internal pressure of 5 lb. per square inch. Most of this leakage occurred in the upper half of the pipes. For slag concrete, the leakage was only about 5500 gal. per hour per day. Although the stone concrete did not give very satisfactory results due to decreased density near the top, such leaks would soon become filled with silt and no undue leakage would result.

The internal pressure required to crack the pipes was 25 lb. per quare inch for the stone concrete and 32 lb. per square inch for the slag concrete.

CONCLUSIONS

The author gives the following conclusions as the result of these tests:

1. Reinforced-concrete pipe, when properly made and properly cured, is very satisfactory for the construction of sewers.
2. The use of a concrete cradle greatly increases the stiffness of the pipe and raises the load under which initial cracking takes place.
3. For sections of the size tested and for smaller sections, the placing of the reinforcing near the inner face throughout the entire circumference seems to be justified.
4. The matter of curing should be very carefully controlled, as much stronger pipe will result if care is taken to keep them thoroughly wet, preferably for a period of two weeks.

Finally, the manufacture of concrete pipe should be much superior to that of ordinary construction. Not only should the quality of the available material be carefully investigated, but density tests should be made in order to combine these materials in such proportions as to produce the densest possible concrete. Density and elastic strength are absolutely necessary for good concrete sewer construction.

Meters Cut Omaha's Water Consumption 20 Per Cent

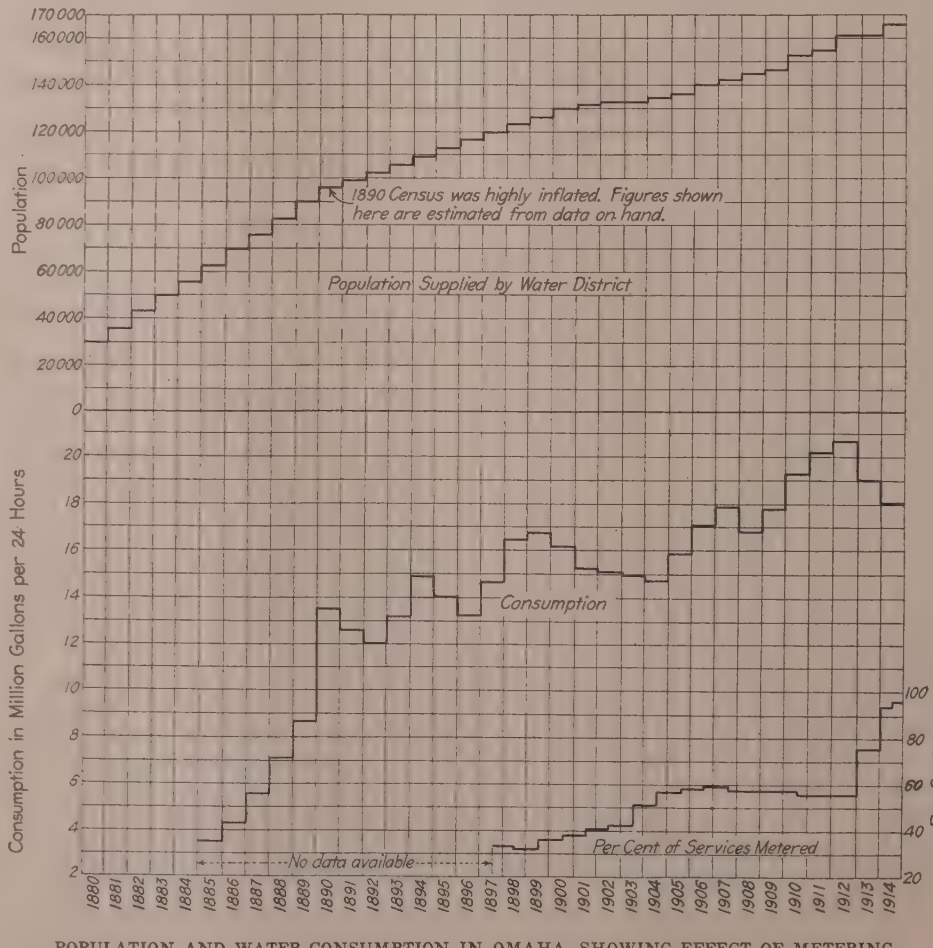
Increase in the Percentage of Services Metered From 56 to 95 Saves 2,700,000 Gallons Every 24 Hours

SINCE 1912 the daily per capita consumption of water in Omaha has been automatically reduced 20 per cent. Meters did it. The total daily consumption has also fallen 2,700,000 gal. until in 1914 18,000,000 gal. were consumed, although during the same period the population supplied increased from 155,000 to 166,000 persons.

Here is the answer: For nine years previous to 1912 the percentage of services metered remained practically the same, about 56 per cent, while the daily consumption climbed from 14,700,000 gal. in 1904 to 20,700,000 gal., the high water mark in 1912. In 1913 the percentage was raised to 75 and in 1914 to 95 per cent. Previous to the former date a few meters had been added each year and had shown a beneficial effect. The per capita consumption for seven years beginning with 1908 has been 115, 118, 126, 128, 129, 115, and in 1914, 103 gal. Thus far for 1915 it is estimated as 96 gal.

Meters are installed under the general direction of George T. Prince, chief engineer, Omaha Metropolitan Water District, for which R. B. Howell is general manager.

ECONOMY IN REINFORCED-CONCRETE STRUCTURES as compared with steel construction is computed at from 10 to 20 per cent for building columns and floors by T. A. Watson in a paper presented before the Concrete Institute, London. He asserts further that reinforced concrete is nearly always the most suitable material for bridges up to at least 300 ft. in span. There are exceptions, but the mere question of cost of maintenance of a steel bridge is enough to condemn it; and this, coupled with the fact that the life of many wrought-iron bridges has been only about 65 years and that steel cannot be expected to last any longer, is a strong argument in favor of reinforced concrete. Apart, however, from the question of maintenance, the saving effected in cost of reinforced concrete over steel bridges is sufficient to justify its adoption, as much as 40 per cent having been obtained in a bridge of 42-ft. span, 26 ft. wide between parapets.

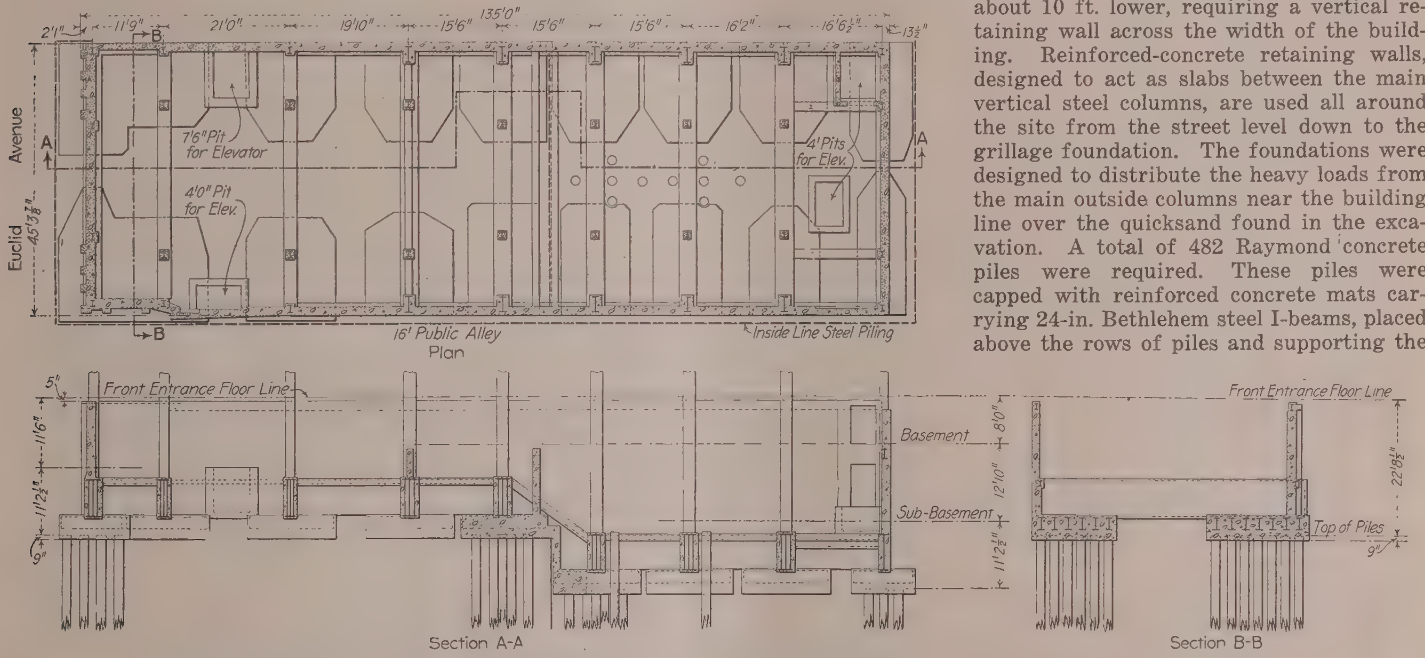


POPULATION AND WATER CONSUMPTION IN OMAHA, SHOWING EFFECT OF METERING

Heavy Trusses and Foundation Girders Used in Steel Bank Building

Clear Bank Floor and Cleveland Building Code Requirements Govern Structural Arrangement of Thirteen-Story Building

THERE is now being constructed in Cleveland a narrow and relatively high steel-frame building for the Union National Bank, at 308 Euclid Avenue, on the corner of a 16-ft. alley. This situation required a 9-ft. decrease in the width of the building above the third floor for all except the three front bays, in order to comply with the section of the Cleveland building law governing light requirements for courts. This feature, combined with the necessity for the largest possible clear floor space for the main bank room, required the use of heavy steel trusses to support the columns carrying the upper floors, which had to be set back about 9 ft. In addition to this special construction the foundations on quicksand necessitated the use of many reinforced concrete piles capped with large grillages inside the property line, and very heavy three-web steel girders to safely distribute the column loads to these foundation grillages. The heaviest of these girders weighs about 42 tons.



REINFORCED-CONCRETE MATS ON PILES SUPPORT HEAVY THREE-WEB FOUNDATION GIRDERS CARRYING MAIN COLUMNS

General Plan and Dimensions

The building is 45 x 135 ft. in plan, and 210 ft. high from street level to pent house roof. The foundations are about 22 ft. below the street grade at the front of the building, and nearly 10 ft. lower in the rear. The accompanying plan of the basement and foundations shows the location of columns, grillage mats and the heavy foundation girders, while the basement walls and other details are indicated in the sectional views. The building contains thirteen floors, spaced 11 ft. 7 in. apart except at the first and thirteenth, where the spacing is 46 ft. 11 in. and 15 ft. 6 in. respectively.

The general arrangement of the columns was fixed mainly by requirements for the large open bank room (which contains three mezzanine floors, front and rear, for small offices), by the details of the front entrance and by provisions for stairways and elevators. The main bank floor is 7 ft. above the entrance vestibule and sidewalk level. Four elevator shafts are provided, as shown in the plan view, two in the front and two in the rear. The building is finished on the front, and with one bay return on the alley, with a limestone facing; the sides are finished with Kittanning brick. Terra cotta is used for the main cornice and all copings, and unusually deep window reveals require special plate and strap design to support the stone facing.

Loads and Allowable Stresses

In addition to the dead load weight of the structure, the live loads specified in pounds per square foot are: All roof surfaces, 35; pent house floor, 100; bank room and first basement, 125; all other floors, 80. The dead load weights of practically all floors averaged about 100 lb. per square foot. The steel framing for the main roof was level and a 3-in. to 23-in. cinder fill provided the necessary slope. The bank-room ceiling with ventilating ducts above weighs, per square foot, about 40 lb., and the bank wall furring, 30 lb. In computing column loads, the stair construction was assumed at 60 lb. per square foot of horizontal area, and the live load on the stairs at one-half that on the floors.

According to the Cleveland building code the live loads are reduced by certain allowable percentages from the top down, using 75 per cent at the thirteenth floor, 70 per cent at the twelfth floor, and decreasing by continually smaller proportions downward. The final average on the foundation is just a trifle over 50 per cent of the total possible live load, assuming all floors to contain the same area. Wind load is specified at 20 lb. per square foot, acting on the surface from the pent house coping to the street grade.

The allowable unit stresses used in the design were 16,000 for steel in tension and bending, and 16,000 — 55 l/r for compression in steel columns. For the length ratios used, the latter formula agreed closely with the values obtained by the formula in the Cleveland building code. Members subjected to wind stress are designed by using either the area required for dead load and live load at the above unit stresses, or that required for dead load, live load and wind load at unit stresses increased by 25 per cent, whichever is greater.

Construction of Foundations

The foundations are not level throughout, but the three rear bays of the building are about 10 ft. lower, requiring a vertical retaining wall across the width of the building. Reinforced-concrete retaining walls, designed to act as slabs between the main vertical steel columns, are used all around the site from the street level down to the grillage foundation. The foundations were designed to distribute the heavy loads from the main outside columns near the building line over the quicksand found in the excavation. A total of 482 Raymond concrete piles were required. These piles were capped with reinforced concrete mats carrying 24-in. Bethlehem steel I-beams, placed above the rows of piles and supporting the heavy 6-ft. plate girders built up of three webs and twelve angles, as already mentioned.

Foundation Girders

The details of these girders are shown in the accompanying drawing, as well as the main columns, the trusses and typical framing connections. As no uplift due to wind was developed, it was possible to rest the columns upon the tops of these girders and rivet them on the outer gage lines of the outside flange angle, a rigid connection and end tie plates being provided as shown. The method of assembling such three-web girders is suggested in the fact that no flange rivets are used between the cover plates and the inside flange angles of the outer webs. The cover plates are first riveted to the flange angles of the inside web, the two outside built webs, which have been riveted up, are then assembled with this third or middle web.

The heavy main sections of these girders are required to resist the bending stress developed by the eccentric application of the resultant foundation pressure about 7 ft. or more inside the main columns. The center of this foundation pressure is located at the center of gravity of the piles in the foundation mat, which is not always at the center of the latter, because the piles are sometimes unsymmetrically distributed. The connection of the intermediate column to this girder is made by the use of lug angles shop riveted to the flange angles of the inside webs and field riveted through the vertical legs as indicated on the drawing. Although the girders and grillage beams are encased in concrete, the concrete was not considered in computing the stresses.

Columns and Large Trusses

The main columns are of a built I-section with 28-in. web plates up to the heavy trusses in the ceiling of the main bank room, which is nearly 47 ft. high from floor to floor. These columns are supported laterally by two rows of struts to reduce the unsupported lengths. Above the second floor, 15-in. webs for the columns up to the ninth floor are used, then another reduction in width is made to 10-in. webs. The required variation in sections for economical design is provided by adding side plates and fillers where necessary. As shown in the accompanying details, the wind-load bending moments are provided for by the use of gusset plates which are spliced to the main webs of the columns and connected to floorbeams or struts. Substantial milled splices, with splice plates on four sides, as shown, are provided about 2 ft. above the floor level, the columns generally being detailed in three-story lengths.

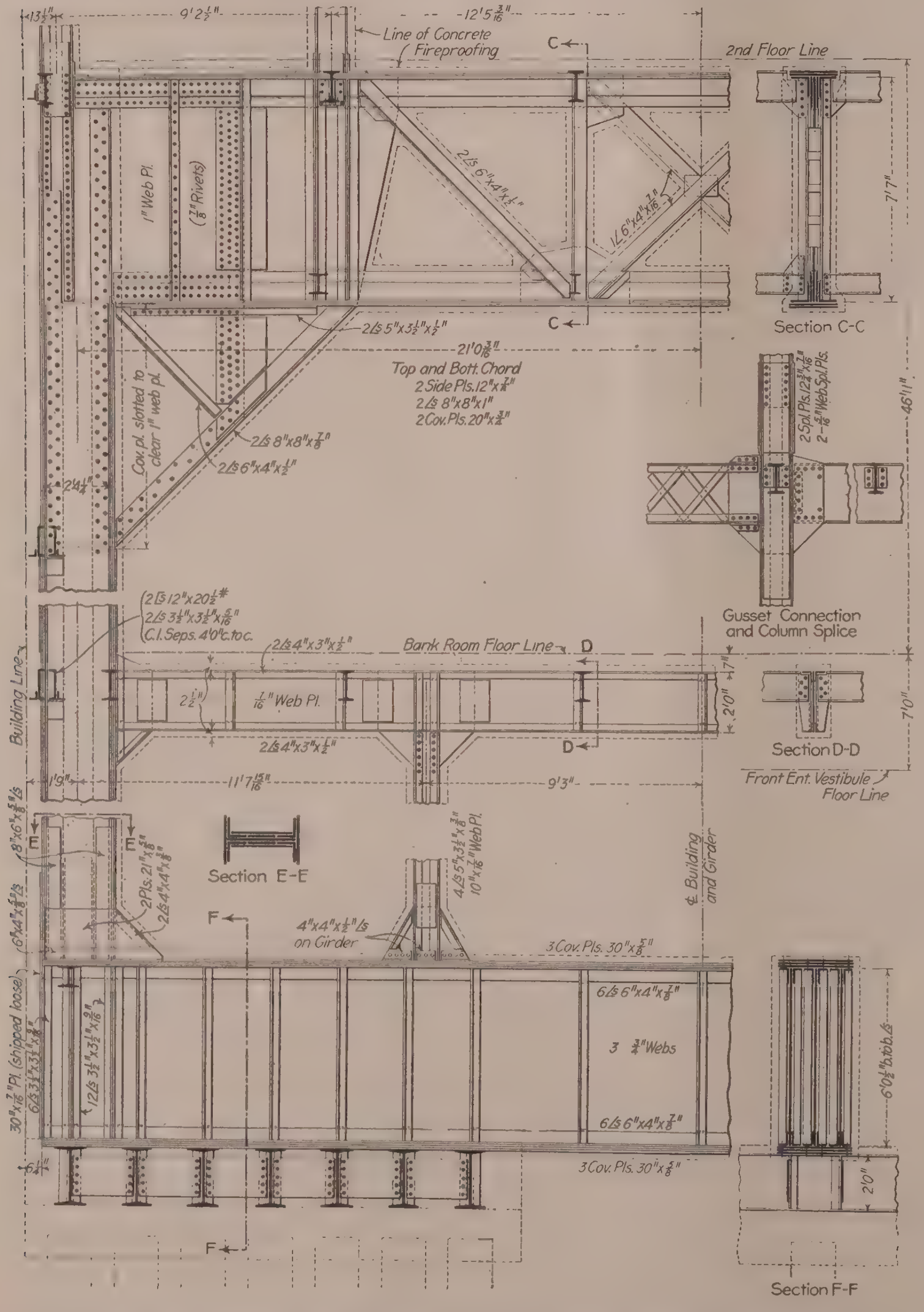
The heavy main trusses in the ceiling of the bank room are 42 ft. in span and nearly 8 ft. deep, with the exceptionally heavy sections shown on the drawing. They support the exterior columns on the alley side, and symmetrical interior columns at the points indicated. The large end gusset plates are spliced in order to allow shipment with the trusses without exceeding railroad clearance requirements. The deep bracket connection to the main column is used to develop properly the required resistance to wind load bending moments and also reduce the unsupported length of these long columns.

Floor and Wall Construction

The floors throughout this building are of steel beam and terra-cotta tile arch construction, with beams spaced usually 8 to 9 ft. apart and provided with $\frac{7}{8}$-in. tie-rods to develop properly the arch thrust. Twelve-inch Bethlehem I-beams, 16-in. tile and a 3-in. cement mortar finish constitute the typical construction. The bank floor is of marble laid on a 4-in. cement mortar fill, and requires the use of built plate girders of 18 and 24-ft. spans, as shown in the detailed drawing. All steel is protected by 2, $2\frac{1}{2}$ or 3-in. layers of concrete or 2 to $4\frac{1}{2}$ in. of tile, and the building is fireproofed throughout.

The walls are of variable construction, embracing parapet walls of solid brick 13 in. thick, exterior walls for 150 ft. below the top coping of 4-in. solid brick and 8-in. hollow brick backing, and below this point 8-in. solid and 8-in. hollow brick. Hollow-tile partitions of 8-in., 6-in. and 4-in. thickness are used according to location, and $\frac{3}{4}$-in. plaster finish is required for all interior surfaces, unless special finish be specified.

This building is being constructed by the Crowell-Lundoff-Little Company, general contractors, Cleveland, Ohio. The steel, of which about 1600 tons will be required, is furnished by the McClintic-Marshall Construction Company. Walker & Weeks, of Cleveland, are the architects; T. J. Bryson, engineer for the architects, made the design. The probable total cost of the building is $700,000, and construction is actively proceeding.



FOUNDATION GIRDERS, HEAVY TRUSSES AND COLUMNS, SHOWING CONNECTIONS

Clearance requirements for shipment necessitated splice of heavy 1-in. plates between columns and trusses as shown. These plates were shipped loose to avoid damage in transit.

San Diego Must Save All Available Water

Inexpensive Flood Water Dam of Single Storm Capacity Equalizes Flow Through Conduit Leading to Storage Reservoir

EVERY gallon of water used in San Diego during nine months of the year must be stored. The population of the city in 1910 was 37,000, but at the present time 100,000 people are supplied with water from the municipal plant. Although the rainfall in the mountains may reach 30 in., evaporation is excessive and the engineers can see plainly that the material growth of the city depends on providing beforehand the necessary amount of water. Every possible scheme for the conservation of water has been studied and on many of the watersheds detailed reports have been made. They are contained in the latest annual report of the water department, from which the following notes have been taken to indicate how the engineers are bending every energy to get more water and also to conserve every drop of the supplies already developed.

Storm Water Regulator

In 1909 the Dulzura viaduct, $13\frac{1}{2}$ miles long, was constructed to divert water of Cottonwood Creek, a tributary of a stream flowing into Mexico, over a divide into a stream above a series of reservoirs in the San Diego System. Morena dam on Cottonwood Creek has a capacity of 15,000,000,000 gal. By the construction of a $60,000 dam on Pine Creek near the head of the viaduct, 500,000,000 gal. can be retained from flood flows and passed down the viaduct to the reservoirs below, leaving the reservoir empty ready for the next storm. During the past season three times the capacity of the reservoir could have been saved. The new dam will conserve most of the waters of this 96-sq. mi. watershed, and enable the officials to keep the viaduct in operation most of the time.

DAM COMPLETED

Excavation on the dam site, which is of the thin-section, concrete-arch type, has been completed and excellent abutment walls have been obtained. The top of the dam is 61 ft. above the stream bed and the radius of the upstream face will be 135 ft. The average unit stress has been estimated at 12 tons per square foot. The width at the top will be 4 ft. and at the bottom 22.7 ft. The deflection due to a change in temperature of 80 deg. Fahr. will amount to 0.001 in., all of which it is estimated will be cared for by the arch ring, either with the reservoir full or empty.

The dam is being constructed by force account under the direction of H. A. Whitney, hydraulic engineer, and will be finished in time to catch the December floods.

SEEPAGE WATER SAVED

Due to the enormous fissures in the porphyry rock upon which the Lower Otay dam is built, there is a seepage amounting to 225,000 gal. daily. To overcome this leak as much as possible a small reservoir was built for the purpose of impounding a day's seepage, which is then pumped back into the reservoir. In blasting the foundation for the engine and pump a large fissure of live water was encountered, showing that the entire wing wall was fissured. The pump is run from 8 a.m. until 4 p.m. and the cost of pumping per thousand gallons, including the wages of the pump runner and fuel, amounts to 3 cents.

When water is turned loose at the Morena dam it runs in the natural bed of Cottonwood Creek for 8½ miles. About one-half of the water is lost in transit, so a small diversion dam, 1½ miles below the dam, was constructed and the viaduct has been built to connect with the present intake. Incident to this work was the construction of a road up a rough canyon, where part of the road was blasted from solid rock.

Pipe Tunnel Backfilled Through Auger Holes

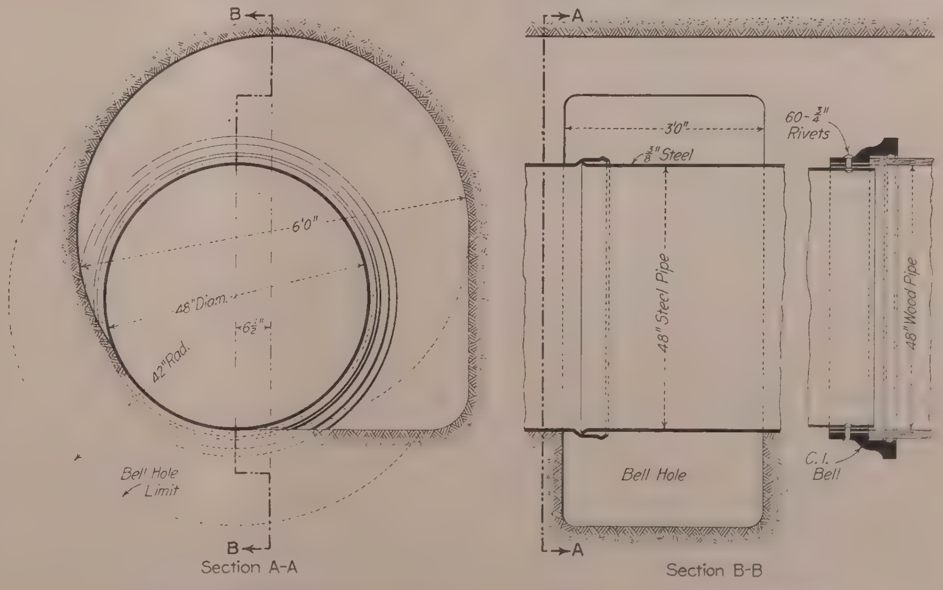
Horizontal Transportation of Earth Was Obviated and a Water-Settled Backfill in the Tunnel Was Secured in Denver

TO backfill a water pipe in a tunnel carrying the new 48-in. conduit for the Denver Union Water Company 8-in. auger holes, 10 ft. apart, were bored upward from the tunnel and loose earth was dumped down the holes. The new line is 6 miles long and connects the north tower of Marston Lake with the distribution system of Denver. It is to be completed in time for the heavy draft of this summer's irrigation period. Eventually this $300,000 line will be extended 3 miles to the Ashland Avenue reservoir.

EARTH BACKFILL WAS DELIVERED TO PIPE TUNNEL THROUGH AUGER HOLES

To keep the conduit below the hydraulic gradient at Loretto Heights a cut of 39 ft. or a tunnel was necessary. As the clay was stiff a tunnel 850 ft. long was decided upon, with a steel pipe to take the place of the wood-stave conduit for a distance of 1400 ft. The tunnel is not lined but the whole tunnel cross-section is backfilled and the earth settled with water. To obviate carrying the earth back into the tunnel from the portals or from the four shafts the auger-hole method was devised. After the earth adjacent to the holes was thrown down water was turned into the holes to make sure that the earth was compact around the pipe. The craters at the top of the holes were filled with material taken from the tunnel excavation.

D. G. Thomas, chief engineer of the Denver Union Water Company, devised the auger-hole scheme.



CONNECTION BETWEEN WOOD-STAVE AND STEEL PIPES IN DENVER LINE

Promotion by Competitive Examinations Is Undesirable

ACCORDING to a committee on salaries and grades of the Municipal Engineers of New York City promotion by examination tends to advance men who have a willingness and taste for studying civil-service methods and preparing for examinations, and to eliminate men inclined to give their best efforts to the work in hand. Especially is this true in professional technical employment beyond grades rated at $2400 a year. Beyond such limits intelligent and fair appraisal should supersede examinations, excepting some effective and fair qualifying test.

Good men are attracted and held not alone by salaries but by the conditions under which they work. The efficiency of the Board of Water Supply force compares favorably with any large public or private engineering organization. This Board has been noted also for its esprit de corps and enthusiasm for its work. These desirable qualities, the report states, were obtained by selecting the most suitable available men for the leading positions, giving great weight, not only to technical fitness, but also to those personal qualifications which cannot be learned or rated by examinations.

REPLACEMENT OF ALL HORSE-DRAWN VEHICLES by motor service wagons and auto trucks has been recommended by Herbert R. Fay, superintendent of the San Diego Waterworks Department.

Dragline Cableway Is an Effective Tool for Sand and Gravel Plants

Low First and Maintenance Costs, Combined with High Efficiency, Make This Type of Installation Superior for Moderate Sized Plants

By W. H. WILMS
Superintendent, Lafayette Gravel & Concrete Company, Lafayette, Indiana

WITH THE INCREASE in the use of gravel for concrete and road purposes has come an increased demand for gravel-washing and screening plants of moderate capacity and cost. The sand and gravel industry being essentially a local one, conditions are generally favorable to the operation of the small-capacity plant; and as the industry develops and new deposits are opened up we may expect to see a large increase in the number of such plants. For gravel-washing and screening plants of small or moderate capacity the dragline cableway excavator, where conditions are at all favorable to its use, is without doubt the most efficient and satisfactory machine for excavating, conveying and elevating the material to the top of the plant. The adaptability, wide range of operation, simplicity of both construction and operation and low cost of operation of this type of excavator are as yet little realized or appreciated by sand and gravel operators.

ECONOMIC CONDITIONS

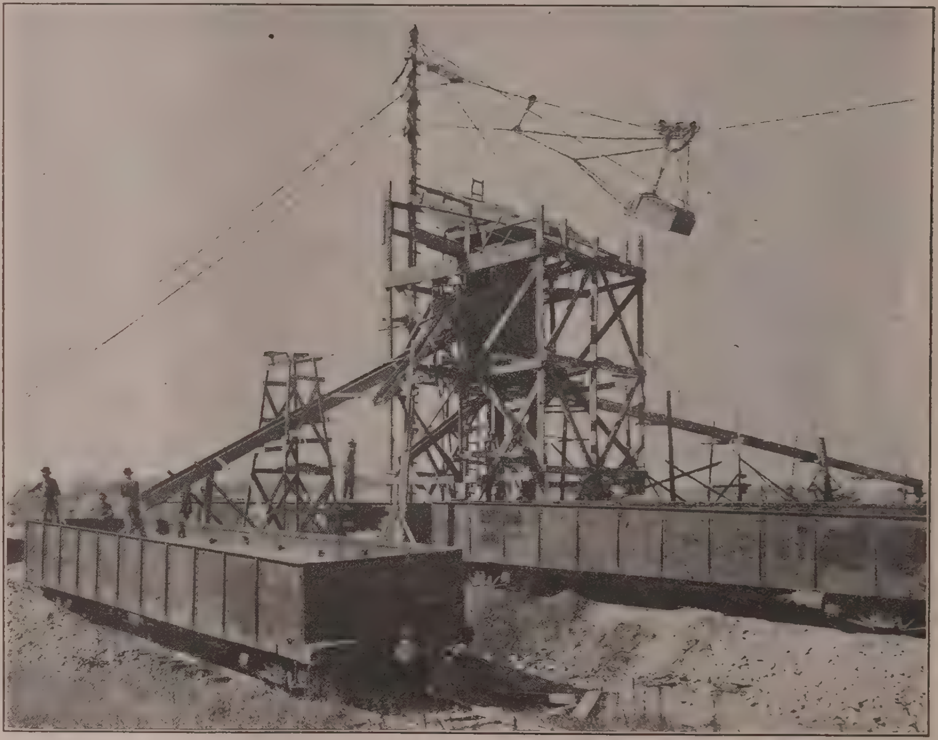
Before entering upon the details of equipment and plant the writer will make a few remarks concerning conditions in the industry that must be fully considered before any decision can be arrived at as to the amount of investment justifiable in any development under consideration.

It should be remembered that due to the comparatively low value of the product and to the high freight rates on it, the sand and gravel industry is strictly a local one, 30 or 40 miles being the average haul of the material. With few exceptions the market is limited to points in the territory served by the railroad on which the plant is located.

In the Northern States 200 days is considered the operating year for the gravel industry, the season beginning in the late spring and ending in the late fall or early winter, depending on weather conditions. As a matter of fact, however, the operating year is generally much shorter than this. In a great many localities the late spring and early summer business is just about sufficient to pay operating expenses, reducing the season of profitable operation to about 150 days. This results in a high interest charge on plant and equipment, idle practically one-half the year. This is one of the chief reasons why a small plant with a relatively small investment can make such a favorable showing as regards both cost of production and profits when compared with the larger installations. A plant may operate at a very low cost of production, labor, fuel and repairs alone considered; but when this high interest charge is considered the cost of production may be much greater than that of a less efficient but cheaper plant.

In figuring on the cost of screened gravel it should be remembered that a plant is quite likely to have a surplus of one grade of material, usually the sand, which must often be sold on a very narrow margin of profit. Most gravel deposits contain a greater percentage of sand than gravel, and with the demand for gravel exceeding the demand for sand, the big problem of many producers is to find a market for this surplus sand.

The importance of keeping the initial investment in property, plant and equipment down to a minimum cannot be too strongly emphasized. The investment of too much capital, largely as a result of failure to investigate thoroughly and analyze conditions, has been the cause of the poor showing made by many plants that otherwise might have been good dividend producers.


TRIP CHAIN BEGINS TO OPERATE AS BUCKET NEARS DUMPING POSITION

In making the preceding remarks on the conditions in the sand and gravel industry it was not the writer's intention to convey the idea that the field is an uninviting one, for such is far from being the case. There are many successful plants in operation earning from 15 to 30 per cent on the investment, and furthermore, the writer believes that the industry has even a greater future. Mistakes have been made in this as in other fields, however, and it is merely the purpose of this paper to point out some of the essential features which must be carefully and fully considered if the enterprise is to produce profits as well as sand and gravel.

DRAGLINE CABLEWAY EXCAVATOR

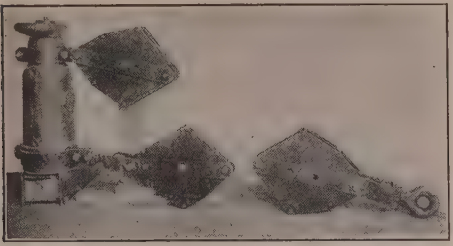
The beginning of the dragline cableway excavator dates back only a comparatively few years. During this time a great many poorly designed and constructed buckets have been placed on the market, and installations with totally insufficient power have almost been the rule rather than the exception. In many instances the machine has been put up against conditions for which it was not adapted and for which it never was intended. Where the machine has been properly designed and installed, and operated under conditions favorable to it, however, it has proved extremely efficient and economical, and is destined to have a still greater field of usefulness when its many advantages are realized and appreciated.

One great advantage of the dragline cableway excavator when operating in connection with a gravel-washing and screening plant is the very low operating cost, a plant of 400 cu. yd. capacity requiring a force of only four or five men—all laborers with the exception of the engineer. This results, of course, from the elimination of any intermediate handling devices, such as cars and locomotive, belt conveyors and bucket elevators, the cableway excavator performing all the operations of digging, conveying and elevating with a crew of only two men—an engineer and a fireman.

The height necessary to elevate the bucket to insure a rapid gravity return on the spans ordinarily used (300 to 500 ft.) is just about equal to the required height of the screening plant served by the excavator. This is one of the reasons why this machine shows such a high degree of efficiency when operated in connection with a screening plant.

PRINCIPLE OF OPERATION

The dragline cableway excavator consists of a bucket carried on an overhead or track cable and a drag or load line. The machine is operated and controlled by a double drum hoisting engine. One end of the track cable is securely fastened to a suitable anchorage and the other end is supported by a mast or tower. The track cable can be pulled taut or slackened by means of a set of blocks and lines leading to the rear drum of the engine. The



SWIVEL MAST-TOP CASTING AND BLOCKS

drag line leads from the bucket over a sheave on the mast to the front drum of the engine.

In operation the bucket is lowered into the excavation by slackening the cables and is then drawn forward until filled. While the bucket is loading the track cable remains slack; as soon as the bucket is loaded, the operator gradually tightens the track cable and at the same time hauls in the load or drag line, so that the bucket is lifted and pulled in to the dumping point simultaneously. The empty bucket returns to the loading point by gravity, the operator simply releasing the friction of the load-line drum.

Of course the capacity of the excavator depends on many factors, such as effective working span and depth, power available, efficiency of operator, nature of gravel, whether compact or loose, and whether or not the machine is handling dry material or material below water, the machine showing a greater efficiency in wet material than in dry. It might be said, however, that the 1-yd. machine working in either wet or dry material, on an average span of 500 ft. and a depth of about 35 ft. has easily averaged 35 cu. yd. of material per hour excavated and conveyed to the top of a screening plant 60 ft. high. The 1½-yd. machine, operated by a 10 x 12 engine under similar conditions, has averaged 50 cu. yd. per hour. There are many sources of delays about a gravel plant, however, such as "spotting" of cars, switching operations, screen trouble, etc., that will reduce this output considerably when the daily capacity of the plant is considered. However, under ordinary conditions, with the above working span and depth, the 1-yd. machine should easily average from 200 to 250 cu. yd. and the 1½-yd. machine from 350 to 400 cu. yd. per day.

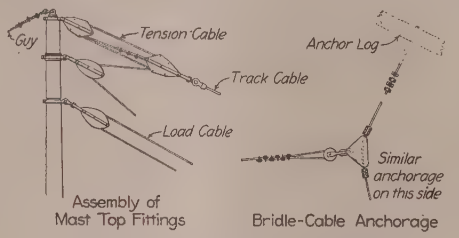
BUCKET REQUIREMENTS SEVERE

The most important feature of the bucket is the method by which the dumping or discharge is effected, and it is here that many an otherwise satisfactory bucket falls short of attainment. Buckets that depend on the action of a latch or lock to hold the bucket and control the discharge have not proved entirely satisfactory, the track cable having to be entirely slacked off before the bucket will latch, resulting in considerable lost time with a consequent decrease in the capacity of the machine.

Buckets that depend on the tension in the drag line to prevent them from dumping while traveling up the track cable have the disadvantage of scattering the discharge when the tension is released for dumping, the carriage running backward down the cable 5 or 10 ft. before the bucket is completely emptied. To be effective the discharge of the bucket should be under the positive control of the operator and should permit of either an instantaneous or a slow discharge.

Flexible chain connections between the bucket and the carriage are to be preferred to rigid connections. This is especially true when working against the face of the excavation. In such cases the bucket must often excavate and take its load in an inclined position, and where the carriage is rigidly attached to the bucket the weight of the carriage causes the bucket to become top heavy and fall over on its side the moment it lands on the slope of the bank. A comparatively long chain connection, however, will prevent this and at the same time permit the carriage to clear the bucket and prolong the life of the carriage sheaves by keeping them away from the excavation, where the abrasive action is greatest.

The position which the bucket assumes in traveling up the track cable is also of importance. Some buckets are so hung from the carriage as to permit only a partial loading of the bucket.



Assembly of Mast Top Fittings

Bridle-Cable Anchorage

CORRECT RIGGING FOR DRAGLINE

The work that the dragline bucket is called upon to perform is very hard and severe, requiring an extra strong and substantially built bucket. Lightly constructed buckets have been put up against this service only to go to pieces in a very short time.

AN EFFICIENT BUCKET

An efficient and well constructed bucket is illustrated on page 716. The writer has had considerable experience with this bucket, and in his opinion it is one of the best and most efficient buckets made. The photograph shows quite clearly the details of the bucket, chain mountings and method of dumping. This dumping arrangement puts the dumping operation under the positive control of the operator, it being possible to dump the bucket quickly or slowly as conditions require.

The bucket is mounted on the carriage by means of chains which allow the bucket to move freely when digging and at the same time prevent any undue strains on the carriage or track cable. The dump chain is made sufficiently long so that the load can be pulled in at full speed against the stop button, as the shock caused by the impact of the traveler block with the stop button is absorbed in the chain mountings. The carriage, after the traveler block engages the stop button, moves half as fast as the load-line cable. This feature is important, as it allows the operator to hit the stop button at full speed, and at the same time prepare for reversing the operations. In dumping, the bucket assumes a vertical position, thus emptying its entire load.

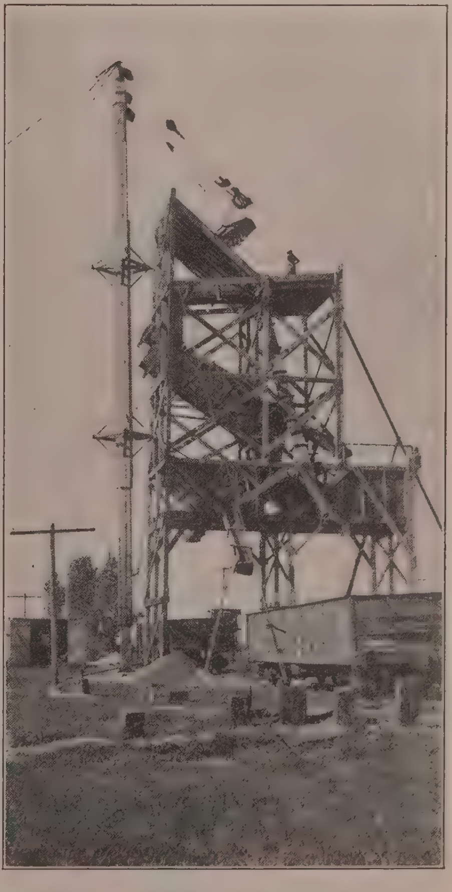
This bucket is known as the Shearer & Mayer bucket (patented) and is manufactured by the firm of Sauerman Brothers, of Chicago.

AMPLE HOISTING POWER ESSENTIAL

In the early development of the dragline cableway excavator the standard hoisting engine, with engine and boiler mounted on the same base, was used almost exclusively for this service; and even to-day installations using the common hoisting rig are by no means uncommon. The excavating of material with a cableway excavator is constant, hard and severe service, requiring a strong and well made engine with a boiler capacity far in excess of that found in the ordinary standard rig, which is designed for lighter and more intermittent service. The solution of the problem is, of course, an independent and larger boiler. For this class of work the locomotive-type portable boiler is probably best suited.

Lack of sufficient power has been the main cause of the poor showing made by cableway excavators in a comparatively large number of cases known to the writer. If the maximum output of the machine is to be realized the loaded bucket must travel faster than 150 ft. per minute—a speed not exceeded in many installations operating with insufficient power.

To obtain the maximum capacity and efficiency of the excavator a rope speed of at least 300 ft. per minute should be obtained on the loaded trip. For operating the 1-yd. machine this means a 9 x 10 double-cylinder engine or its equivalent. With an ample supply of steam at 100 lb. working pressure and a front-drum diameter of 24 in. this engine will develop a maximum line pull of about 5000 lb., which will easily take care of the load while the bucket is digging. It is while digging that the maximum load comes on the machine, which limits the size of the drum that can be used. At a rope speed of 300 ft. per minute this engine with the ordinary gear ratio of 5:1 and a drum diameter of 24 in. will attain a piston speed of about 400 ft. per minute, which is not excessive for this size and class of engine. The 10 x 12 engine with a drum of 26-in. diameter will develop a maximum line pull of about 6500



TRUSSED TIMBER MAST IS ECONOMICAL

lb. and a piston speed of 420 ft. per minute at a rope speed of 300 ft. per minute.

For the operation of the cableway excavator the engine and boiler capacities in table 1 are recommended.

SELECT BLOCKS WITH CARE

Probably the greatest trouble experienced in the operation of the dragline cableway excavator is in the rapid wear, breakage and renewals of the sheaves. The ordinary common derrick block is entirely inadequate to withstand the severe and constant service of this class of work. The tendency has been and is still to use sheaves of insufficient strength and too small a diameter, resulting in constant breakdowns, delays and short life of the wire ropes passing over these sheaves. It has been the writer's experience and observation that it pays to buy the best blocks possible for this service, for the successful and efficient operation of the machine depends in no small measure on the proper specifications for and installation of the blocks. The sheaves in the blocks should be of extra heavy pattern and provided with bronze bushings. The sheave pin should be extra large and should be center-bored and provided with compression grease cups. For continuous heavy duty the block sheaves should be of the hollow web pattern with a large capacity oil chamber in the web.

TABLE 1—RECOMMENDED ENGINE AND BOILER CAPACITIES

Capacity of bucket, cu. yd.	Double-drum skeleton hoisting engine	Diameter of front drum, inches	Boiler capacity, 100 lb. pressure
¾	8¼ x 10 or equivalent	20	30
1	9 x 10 or equivalent	24	40
1½	10 x 12 or equivalent	26	60

TABLE 2—RECOMMENDED SIZES OF BLOCKS AND CABLES AND NUMBER OF SHEAVES

Capacity of bucket, cu. yd.	Guide blocks	Tension blocks	Track cable 6 x 19, plow steel, diameter in inches	Load and tension cables, 6 x 19, plow steel, diameter in inches
¾ and 1	2 singles, with swivel hooks of 16-in. diameter, extra heavy	5-part line; 2 doubles, 16-in. diameter, extra heavy; one with swivel hook and one with special connection for track cable	1⅛ to 1¼	⅝ to ¾
1½	2 singles, with swivel hooks, 18-in. diameter, special extra heavy	6-part line; one double with swivel hook; one triple with special connection for track cable; special extra heavy; 16-in. diameter.......	1¼ to 1⅜	¾ to ⅞
1½ (long spans)	2 singles, with swivel hooks, 18-in. diameter, special extra heavy	7-part line; 2 triples, 18-in. diameter, extra heavy; one with swivel hook and one with special connection for track cable		

The writer's recommendations as to size of blocks, number of sheaves, and size and grade of the load, tension and track cables for operating the ¾, 1 and 1½ cu. yd. machines are given in Table 2.

LIFE OF CABLES

It is quite difficult to obtain very good and reliable results as to the life of the cables, as the conditions vary greatly on the different installations. A great deal of the service obtained from the cables depends, of course, on the operator—how he handles the machine and the care he takes of the cable. Under favorable conditions, however, and on the usual spans of 400 or 500 ft., the load line will average about 20,000 cu. yd. The tension line will give a somewhat greater service, averaging about 25,000 cu. yd. The track cable will average about 50,000 cu. yd.

Although track cable grades as low as 10 per cent can be used in the operation of the cableway excavator, for a rapid return of the bucket and the highest efficiency of the machine a 14 per cent grade is necessary.

The proper installation of the wire-rope guys is very important, as the stresses that come upon these ropes are severe. Plain, ungalvanized cast-steel rope of 6 x 7 construction is recommended for guys. There should be at least six guys about the upper blocks and an extra guy opposite the lower guide block to take the reaction of the load-line pull. One-inch rope will usually meet all of the requirements.

MAST OR TOWER AN IMPORTANT PART OF THE MACHINE

An important part of the machine is the mast or tower. The particular type to use in any given installation will depend on the load it will be required to carry, its height, whether or not the installation is to be temporary or permanent, and the relative costs of the several types in the particular locality in which the plant is located. In many instances a pole or tree of proper length and strength will meet the requirements. To obtain the required strength it may be necessary to truss heavily such a mast. One-piece timbers, 14 x 14 in. or 16 x 16 in., of longleaf or shortleaf yellow pine, or of douglas fir, make very satisfactory masts. The timbers must be heavily trussed to meet the more severe conditions. The sectional timber mast, strongly trussed, is especially adapted to portable outfits, as the longest piece of timber or the longest truss rod can be shipped on a single freight car. Sometimes conditions of load, span and height require a structural steel mast. While the steel mast in point of strength and reliability is superior to the other types, its first cost is often prohibitive, especially for use in connection with a small gravel-screening plant. The 10 and 15-ton derrick masts are recommended for this service.

CARE IN DEVELOPMENT NEEDED

While local conditions in any given case more or less determine the method of development and the place where operations are to begin, an exhaustive study should be made of all the conditions affecting the problem, and every possible advantage of the situation that will lead to a systematic and economical development of the deposit should be taken. Where a dry deposit is being worked, a future increase in the capacity of the plant with a resultant change to steam-shovel operation must often be considered when developing with a cableway excavator; and it is here that such a machine is liable so to "butcher" up a property as to make its future operation with a steam shovel exceedingly difficult and costly.

Under such conditions study should be made and proper judgment shown in the layout and initial development with this type of machine.

Why Engineers Should Be Interested in Publicity

C. E. Drayer Urges Them to Disseminate Accurate Technical News—Favors National Public-Relations Bureau

TEACHING the public that the engineer is above the skilled artisan and that he can be of great public service in aiding his Government locally and nationally are objectives of proper publicity for the engineer emphasized by C. E. Drayer, chairman of the publicity committee of the Cleveland Engineering Society, at a recent meeting of the engineers' division of the Chicago Association of Commerce. Mr. Drayer pointed out that the man in the street is not likely to find out what the engineer can do unless he is told in the layman's language. Engineers have waited long enough for the public to find it out unassisted, and their rewards bear evidence of the fruitlessness of their wait. Unless engineers show that they are leaders, they will always be looked on as followers. The engineer can correct error and misrepresentation so that when questions of public policy are up they will be decided in accordance with proper engineering principles rather than by the whim of the moment directed, perchance, by some small class to further selfish ends.

Mr. Drayer's remarks were in part as follows:

"The country is burdened with wastefulness where engineering skill might save vast sums. For instance, it is planned to spend $100,000,000 on highways in New York State without adequate provision for maintenance. It is hardly possible that such a proposition would have been seriously entertained if the public had waited for the opinion of the engineering profession before making a decision. Again, recently, a proposition to spend $50,000,000 on good roads in Ohio was voted upon without any preliminary studies or surveys as to how the money was to be spent. Had the proposition been approved, the money would have been largely wasted under the direction of jockeying politicians. The attempt of the last Congress to enact the usual pork barrel river and harbor legislation is familiar to us all.

CATERING TO THE JUDICIAL MIND

"At present the Government is spending millions of dollars and requiring the owners to spend many more in making a physical valuation of the railroads. When two vacancies occurred in the Interstate Commerce Commission a year or so ago the suggestion was made to one who had the ear of the appointive power that it would be desirable to have one of the vacancies filled by an engineer. He replied that such a position required a judicial quality of mind, and that the incumbent could surround himself with all the expert service needed. His answer implied that an engineer could not be found possessing the necessary judicial quality of mind. It should be stated that the man who gave this reply was a lawyer.

"It is putting it mildly to say such an opinion indicates a regrettable lack of information in a man directing public affairs. Yet he is not to blame. We should have little patience with the engineer who treats his own calling in an apologetic manner when the means to remove his handicap lie in his own hands.

"Not long ago a mayor in one of our largest cities appointed to the position of director of public service a young lawyer, 25 years or so of age. The young attorney knows well the lure of words and has made some statements, ambiguous to say the least, concerning engineering matters. His statements satisfy an uninformed public but are sometimes rather amusing to an engineer. Again I say the burden to remove this undesirable condition rests on our shoulders. It is worth while to repeat a statement made before, that the public is unreasonable only when it is uninformed. We must resort to the time-worn process of education, often slow, often disappointing, always painstaking, but worth all it costs.

WHAT IS NEWS?

"There is still another reason for publicity by engineers. The public is deeply interested in applied science and the practical applications of science because it knows that its welfare is thereby advanced.

"If the news we furnish the newspapers is to be welcomed by them, it must successfully compete with what we find in them. But what is news? Broadly, it is an account of something that has never been described in print before. Applying the test that what is novel is news, we find an abundance to describe in the engineering and scientific world. The great difficulty is to find the man who can recognize a story, who has a nose for news, and who can dress it in a form that will interest the public and hold its attention.

NATIONAL BUREAU TO CULTIVATE BUSINESS RELATIONS

"We have technical and research societies without number, so many that the public can hardly be blamed for believing that we are interested in material things only, as hewers of wood and drawers of water. Perhaps we need a National bureau to conduct and cultivate business relations with the public, including inter-society relations, publicity, employment and legislation.

"Over the country there is a growing unrest against the direction of municipal affairs by the lawyer and the politician. As said before, the administration of municipal business is largely a function of engineering. Why not enable the public to see this situation in its true light and thereby perform a public benefaction as well as advance our own interests. Positions for engineers would increase in number, likewise compensation. In the matter of at least seeking to prevent harmful legislation, the recent events in this State are sufficiently strong argument to convince Chicago engineers of the need. Always it is easier to combat vicious legislation at its incipiency rather than after it has been enacted into law.

"Proper relations with the public can be carried on very much better by local engineers than by any central bureau acting without the advantage of close contact with the public through the local society. The central bureau and the local society working together would accomplish vastly more than either alone. I am a strong believer in a large all-inclusive local society, and a select National society. Each has separate but parallel courses which should be merged at the proper point to the common purpose of advancing public welfare and enhancing the prosperity of the entire engineering profession."

Thin Concrete Base, Reinforced, May Save 50 Cents a Square Yard in Paving Costs

Prof. James S. Tucker, in Discussing Results of Slab Tests at Oklahoma University, Foresees Marked Economies from Reduced Foundation Thickness

BY THE substitution of a 3-in. reinforced concrete base for the customary plain 6-in. base savings of 50 cents per square yard on pavements costing ordinarily from $1.60 to $2 per square yard, are possible, according to a paper presented before the Iowa State Engineering Society by Prof. James S. Tucker, director of the school of engineering of the University of Oklahoma. Professor Tucker first discusses the merits of grout and bituminous fillers for brick pavement and then cites tests of concrete slabs, made for the Western Paving Brick Manufacturers Association at the university laboratory, to support his belief in the feasibility of reducing the foundation thickness and lowering costs without impairing the quality of the work. Twenty-eight slabs were tested. The aim was to demonstrate whether or not it is possible to so reinforce the concrete foundation of a pavement as to permit a substantial reduction in its thickness and so to effect a marked saving in the cost of the pavement as a whole.

CONCRETE SLABS TESTED

Concrete slabs, representing a section of the pavement 1 ft. wide and of various thickness were made, and when suitably aged were placed in the testing machine and supported on knife-edges 27 in. apart. The load was applied directly to the center of the slab. This is equivalent to applying the load directly to the foundation itself, and it is not transmitted through what would be the wearing surface of the pavement, whatever its material might be. Each slab was entirely unsupported save on the knife-edges at the ends, so that the conditions were similar to what would exist in a street where the foundation spanned an open ditch 27 in. wide. Thus it will be seen that the artificial conditions are much more severe than those which would occur in actual practice.

The average center concentrated load borne by 6-in. plain slabs at 12 days was 1200 lb.; by 5-in. plain slabs at 11 days, 1125 lb.; by the 4-in. plain slabs at 10 days, 630 lb. A 2-in. slab, reinforced with wire fencing in the middle, averaged 460 lb. at 10 days or four-fifths as much as the 4-in. plain slab. Three-inch slabs, reinforced near the bottom, gave 1180 lb. in 10 days, or the same as the 5-in. and nearly as much as the 6-in. slabs. Four-inch slabs, also reinforced near the bottom, gave 1550 lb. in 10 days. One 4-in. slab with three wires, at an age of 27 months, gave the remarkable test of 3000 lb.

The reinforcement used in every case was ordinary commercial, rectangular-mesh hog-fencing of galvanized wire, costing from 3 to 5 cents per square yard in place in the street foundation. The slabs tested had either three or four longitudinal wires, just as it happened to come from the top or bottom of the fencing. The meshes ranged between 5 x 6½ and 3½ x 6½ in. The top of the fencing had wires of ⅛ in. diameter, while the balance were 9/16 in. in diameter, and the transverse knotted stay wires were 7/64 in. In none of these cases did the wires break, except in the 27-month test, but as the ends of the strands were not even turned up, or hooked, and as in numerous specimens the wires were embedded only about ¾ in. from the bottom of the slab, they frequently pulled loose and merely slipped as the upper part of the slab crushed under the load.

The concrete was of the most ordinary sort, made in a hand mixer in proportions of 1:4:5, with ¾-in. limestone and a coarse and a fine grade of sand in equal parts. They were aged in an open field between Oct. 28 and Nov. 12, for the most part. It is thought that no special laboratory advantages were obtained which would render the concrete in any way better than that usually obtained in street practice.

ECONOMIES INDICATED

The outstanding fact plainly shown is that even with this simple and inexpensive reinforcement the 3-in. slab is easily as good as the 6-in. slab of plain concrete, while the 4-in. was about a quarter better.

The real significance, economically, of these tests appears when we consider the cash value of the facts learned. Wherever there is need for a 6-in. base, one 3 in. thick with 5 cents worth of reinforcement will do equally as well. The cash saving is notable since the concrete will cost from 15 to 20 cents per square yard per inch of thickness. Hence this simple use of hog-fencing means from 40 to 55 cents per square yard of pavement actually saved, or 25 per cent saving on a pavement costing from $1.60 to $2. This would mean a saving of $1000 upon about 2000 sq. yd. of pavement, and a small job of paving usually costs several times this amount.

Nor is this all. Having seen that we can do with 3 in. of concrete all that is now done with 6 in., we meet the next obvious question: "Is a pavement base of even that strength ever needed?" It will be observed that the loads of 1500 lb. obtained with the 4-in. slab represent a wagon wheel carrying one-fourth of a 3-ton load. This is probably about twice as great an intensity as would occur for a 10-ton road roller, and somewhat greater than under a large traction engine. Note, however, that the slab tested had the following handicaps: First, the load was applied at the center of a clear unsupported span of 27 in.; second, the slab was discontinuous in both directions, and hence could receive no support from adjacent portions of the concrete; third, this discontinuity, or lack of anchorage, was of vital importance to the reinforcement, since only in the one case of the block aged 27 months did the wires break—that is, the capacity of the wires missed development by from 50 to 80 per cent. Plainly, then, there is an ample factor of safety in assuming that this plan would always give results equally as good in any pavement, and it is reasonable to expect vastly better.

FOUNDATION MUST BE FIRM

The most vital variation between this experiment and practice, however, lies in the unsupported span tested. We certainly need not assume that we must design to meet this non-supported condition in practice, nor need we figure safe loads without taking into account the supporting power of the subgrade. Let us make a few comparisons.

Every engineering text on foundations suggests that almost any dry soil can be safely relied upon to carry 2 tons per square foot, if kept free of excess moisture. The soil will be very bad indeed which will not carry 1 ton per square foot, and for particularly good soils it may run to 8 or 10 tons. Taking 2 tons as a reasonable figure for soil which is to have a tight roof—any which may be assumed to have received the attentions of a steam roller—this would give a supporting capacity of about 30 lb. per square inch, running up to six or eight times that with the better soils.

If we consider a 3 x 8-in. brick as receiving a wheel load of 1500 lb., and it is resting on a 1-in. sand cushion carried by concrete 3 in. thick, then, taking the usual assumed divergence of load lines as 45 deg., this wheel load is distributed over 170 sq. in. of earth surface, giving an intensity of 9 lb. per square inch. Since we are counting upon a 30-lb. soil as a minimum, a figure which already includes an ample factor of safety, it is evident that the soil can not be over-stressed, even though we consider the area of concrete loaded as a separate flagstone, and not part of a continuous slab, which it certainly will be.

Without assuming that our foundation has any particular tensile strength, therefore, we are forced to conclude that a soil area of 50 sq. in. would carry the 1500-lb. wheel load with perfect safety, while in fact the area receiving the load is over three times as great as this. This, it is thought, will serve as an ample allowance for the case where the load is applied to the joint between two bricks where there is a non-rigid joint filler.

Thus we have reasoned around to our starting point, the contention of MacAdam that a well-drained and compacted road surface would bear any wheel loads that could be put upon it. We see that if a space 4 in. long under our 12-in. wide test slab had been occupied by soil of the supporting capacity named, instead of the slab having a clear unsupported span, then there would have been no need of reinforcement in it.

Pursuing the logic still further, it appears that the thickness of the slab is of little import, since it is the subgrade which must really and eventually carry the load in any case. As the thinner slabs deflected about ¾ in. without failing, it is seen that the soil area called into support will greatly exceed what is needed to bear any load coming upon the pavement surface.

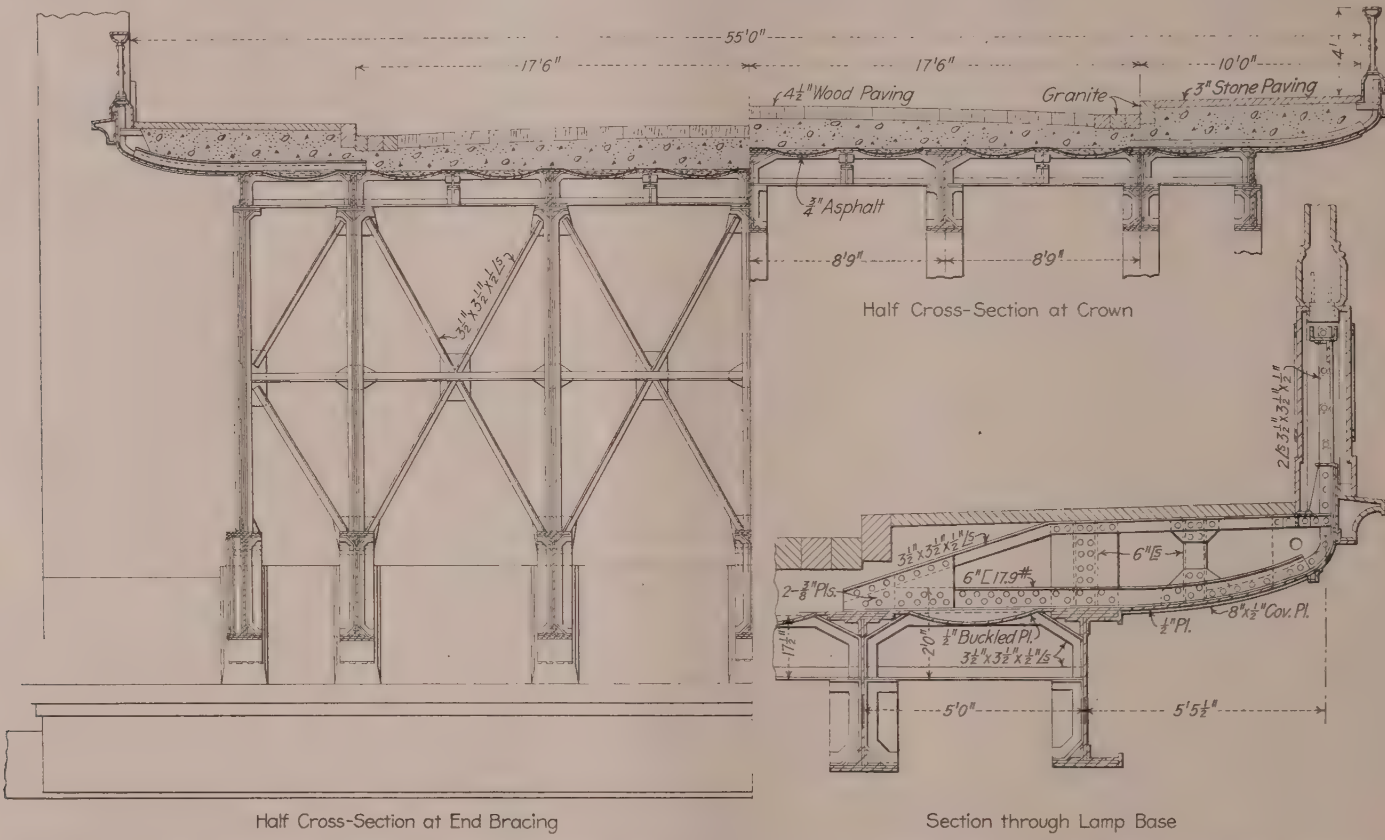
POSSIBILITIES OF TWO-INCH SLAB

This reasoning indicates that a 2-in. slab with the wire in the middle would be amply strong, and would effect a still further saving of money over that already indicated. Professor Tucker is not prepared to recommend this thickness, however, unless the paving specifications are otherwise radically amended, notably in the preparation of the subgrade. He is convinced, however, that an average expenditure of 3 or 4 cents per square yard in excess of the present practice devoted to watering, raking, and continued rolling of the subgrade would render the 2-in. base entirely feasible. He is also convinced that such rolling and painstaking treatment of the subgrade would surpass in effective supporting power and increase pavement stability more than the introduction of four extra inches of concrete foundation as now commonly practised, while the cost reduction might then amount to 30 per cent of the total.

It may here be claimed that this paper first makes a great argument for wire reinforcement, and then shows that it is unnecessary. The practical difficulty of getting a uniform and homogeneous subgrade is freely admitted, even with the care and effort here asked for. This is exactly where the reinforcement comes in—to render the pavement stable and secure from disturbance by reason of such defects in its support, for if these thin slabs with the trifling reinforcement used will, under all the handicaps herein indicated, virtually carry any possible loads over clear spans of 2 ft., it is certainly rational to suppose that they will carry and distribute the loads properly when resting on almost any soil short of liquid mud. This we certainly need not provide for, nor need we regard a general settlement in any pavement as fatally defective.

Old English Bridge Replaced by New Flat-Arch Structure

THE principal reason for reconstructing the old Southwark bridge over the Thames River, London, was the restriction to road traffic caused by the steep gradients on the approaches and on the bridge itself. The old bridge consisted of three cast-iron arch spans, one 240 ft. and two 210 ft. long, carrying a 29-ft. roadway and two 6¾-ft. sidewalks, described in Engineering Record of April 18, 1914, page 442. The new structure consists of five spans, retaining the same 240-ft. center span but with two 128-ft. and two 132-ft. spans of flat-arch type, built of seven steel ribs spaced 8 ft. 9 in. on centers except the outer pair on each side, which are 5 ft. on centers.



SECTION OF NEW SOUTHWARK BRIDGE, SHOWING ENGLISH PRACTICE IN HIGHWAY FLOOR DETAILS—NOTE BENT STIFFENER ANGLES

The accompanying sections of the new bridge suggest the difference in practice between American and English highway bridge floor and arch construction. The piers are of granite and an elaborate ornamental facing is carried up above the side railings as outlined at the piers. As it was desired to utilize the masonry of the old abutments for the new bridge, the distance between the center lines of the outer ribs could not be increased. In order to widen the bridge, therefore, the sidewalks had to be supported on cantilever brackets, which are spaced about 14 ft. on centers. At their outer ends a concealed girder built of plates and angles serves to support the sidewalk between the cantilevers.

These illustrations are taken from an article in "Engineering," of April 30, describing other changes in several bridges over the Thames, and the widening of London bridge.

Beaumont Water Terminal Will Be Built in Units

$3,000,000 Development for Texas Port Will Include Quay Sheds, Warehouses, Factory Lofts and Elaborate Transfer Machinery

By H. McL. HARDING
Consulting Engineer, New York City

TO serve more adequately an area larger than the New England States, a new water and industrial terminal is to be built at Beaumont, Texas, one of the few ports in the State for ocean-going vessels. Beaumont is about 50 miles up the Neches River, and the site secured for the terminal is Kirby Point, which is surrounded on three sides by the river and is located within 1000 ft. of the court house. With the land and water areas there are available about 55 acres for the terminal. The terminal is designed to be built in units, only the first of which is to be constructed at present.

A plan of the terminal is shown, with the first unit indicated in solid lines and the remaining units dotted. A unit length of quay is 500 ft., which is the length of a large freighter. Such a unit is provided with a proportional length of shed, warehouse, necessary railway tracks, and the transferring and handling machinery. A second unit can be installed without requiring any changes in the first unit, and without interruption of traffic.

Each unit complete, including the above elements, with the dray area, and the filling and paving, will make the total investment, exclusive of the land, about $300,000. The seven units with the fish and farm markets, the cold-storage and adminstration buildings, the manufacturing lofts, sheds, railway-approaches and storage tracks, will require an investment of about $3,000,000. The additional units will be constructed according to the demands of traffic.

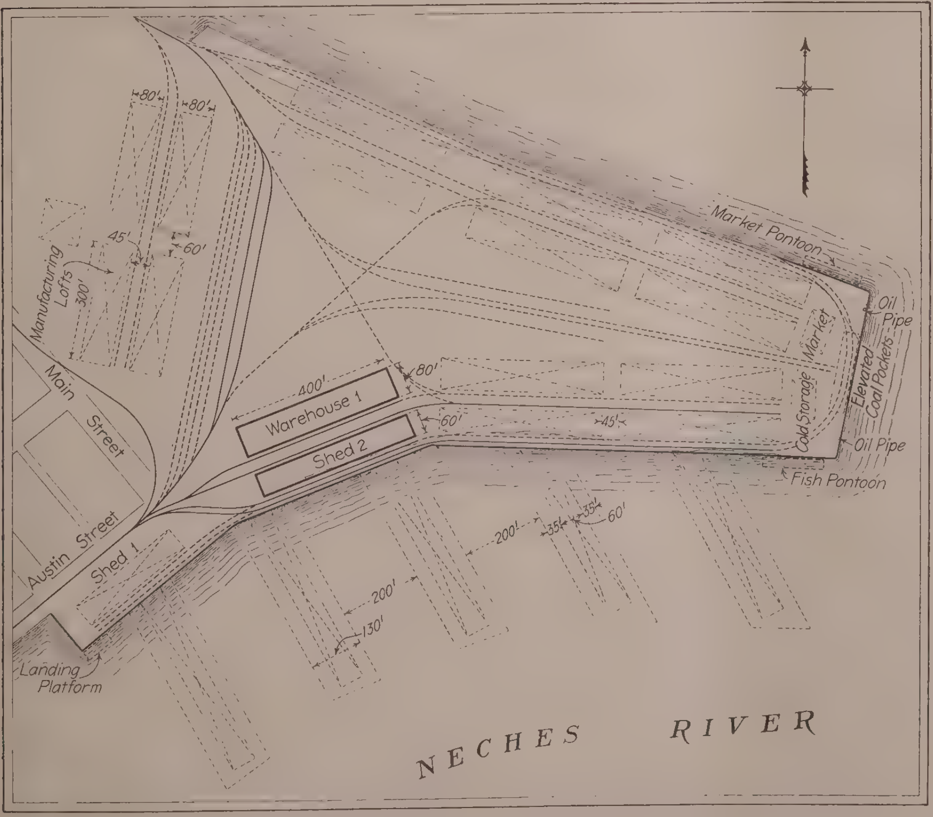
FREIGHT HANDLING EQUIPMENT

Freight is to be transferred by traveling gantry jib cranes, and by the overhead traveling hoists and movable tracks it will be assorted, distributed and tiered in the shed. By other cranes, at the rear of the shed, it will be transferred by one direct movement from the shed to any story of the warehouse.

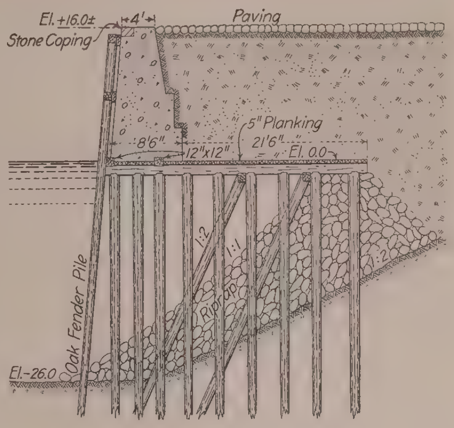
By means of the terminal railway tracks and the present Belt Line Railroad cars can be switched between any of the railroads entering Beaumont and any shed, warehouse or storage place within the terminal. There are to be railway tracks between the shed and the waterway and between the shed and the warehouse, thereby affording complete co-ordination.

Along the river banks of the terminal there will be constructed at first only the concrete quay walls. Later the projection piers will be added, according to the increase of the tonnage. For the present and future development of the industrial terminal there will be, beside the 55 acres mentioned, about 325,000 sq. ft. of pier space, 575,000 sq. ft. of slip space, and 60 acres in addition in the turning basin.

There will be 9275 lin. ft. of frontage over which, when mechanically equipped with the latest appliances and intensively worked, there can be transferred annually more than 3,000,000 tons of miscellaneous cargoes.



THE FIRST UNIT OF THE BEAUMONT DEVELOPMENT IS SHOWN IN SOLID LINES



TYPICAL BULKHEAD SECTION

The seven transfer-sheds on the quays and the five trans-shipment sheds on the piers will be of steel and will have a total holding of short-time storage capacity of 114,500 tons. In the concrete warehouses there will be a long-storage capacity of 150,000 tons. The open storage spaces for outside freight will amount to approximately 300,000 sq. ft.

The concrete manufacturing lofts will have a combined floor area of 620,000 sq. ft. There will be an administration building, farm and fish markets and cold-storage facilities. Coal pockets and oil pipes are located where vessels can be supplied with the least discomfort to the remainder of the terminal.

TWO TYPES OF CRANES

There will be two types of cranes, the half arch and the other the full arch. These will take normal loads of 3 tons and have an over-reach of 45 ft. They will be operated by direct-current electricity at 550 or 200 volts. There will also be transfer bridges for lumber and structural steel, and conveyors for special commodities. In the sheds will be overhead traveling cranes and electric traveling hoists, of a hoisting and carrying capacity of 2 tons each, for the assorting, distributing and tiering of miscellaneous freight. The hoists will be operated in trains. For long movements, motor trucks will be used.

The quay walls above low water will be composed of concrete, no wood entering into the construction except that which is below low-water line. A typical cross-section is shown.

It is expected that the first unit will be completed and ready to add to the capacity of the present wharves in a few months.

THE WAR-TIME ADVANTAGES of Government ownership of railways, often cited as one of the main arguments for such public ownership, has been shown by the successful private operation of the French railways to be largely imaginary, according to an editorial in London "Engineering." Quoting from that journal, "The relations between the State and the railway companies in France have resulted in the establishment of railway systems and working conditions of great effectiveness in war time. When required, the War Department can command the whole plant, whilst benefiting to the fullest extent by the experience and technical knowledge of the companies' staffs. Moreover, the services rendered to the State cannot be said to be of an expensive nature; the cost would be much higher than it now is were the State to own even part only of the plant which is so readily placed at its disposal when needed."

Knowledge of Affairs Needed by Engineers

Professor Ira O. Baker, in Address to Triangle Fraternity, Suggests Ways of Increasing Technical Men's Influence

WRONG IDEALS, involving too great specialization in technical detail to the exclusion of more broadening interests, is responsible for the engineer's failure to attain the position he might occupy in the estimation of the public. This is the belief of Prof. Ira O. Baker, until recently head of the civil engineering department of the University of Illinois, as expressed in a speech at the recent annual convention of Triangle, an engineering fraternity.

WRONG IDEALS

Professor Baker said, in part:

"I am persuaded that the chief reason why the engineer does not attain to the position in the public estimation which he might occupy is because of wrong ideals. The representative engineer magnifies the importance of technical matters. In college he is insistent upon acquiring a so-called practical education, that is, he desires to specialize and to take only the subjects immediately connected with his chosen profession. As a consequence, he lacks breadth of view and is weak in knowledge of non-professional matters. Too often he has sought to perfect himself in technical details to the neglect of a knowledge of political procedure, of business methods, of labor conditions, or of social problems. Further, he is often seriously deficient in the ability to use correct and forceful language.

"What then can the engineer do to improve his position in society, or rather, what can you do to prepare yourselves for a wider usefulness and a larger success? I have several definite suggestions:

"1. Conserve your health, be strictly honest, and keep your heart pure.

"2. By continual care and practice cultivate the ability to express yourself in writing and in oral speech in clear, concise, correct English. There is nothing more necessary to the young engineer who desires to attain more than a mediocre success.

"3. Extend your horizon by reading and study of industrial and political history, political and social science, economics, labor problems, principles of banking, rate regulation, and other vital subjects that will suggest themselves. There are numerous volumes on any of these subjects that are intensely interesting and instructive.

KNOWLEDGE OF AFFAIRS

"4. Do not become a man of technical details nor a man of books to the exclusion of a knowledge of affairs. In the first place, the successful engineer must buy materials; and therefore he must have a knowledge of market conditions and of business methods. These come only by close observation. Notice that I do not say they come by experience. Of course, they come through experience; but experience alone does not give the necessary knowledge. They come only through thoughtful observation and careful analysis. In the second place, a successful engineer directs the labors of others; and therefore he must know much of the motives that influence men, and must understand the point of view of organized labor, and should have at least some knowledge of the advantages and disadvantages of the different methods of payment. In the third place, an engineer is frequently called upon to report upon projects; and therefore he should be able to foresee all the industrial, commercial, and financial conditions involved in the project, and should be able to accurately discriminate as to the relative importance of the various conflicting factors. In the fourth place, the engineer writes specifications and makes contracts; and therefore he should know something of the intricacies of the law. In short, the successful engineer must have technical knowledge, but he must also be a man of affairs, knowing men and business methods.

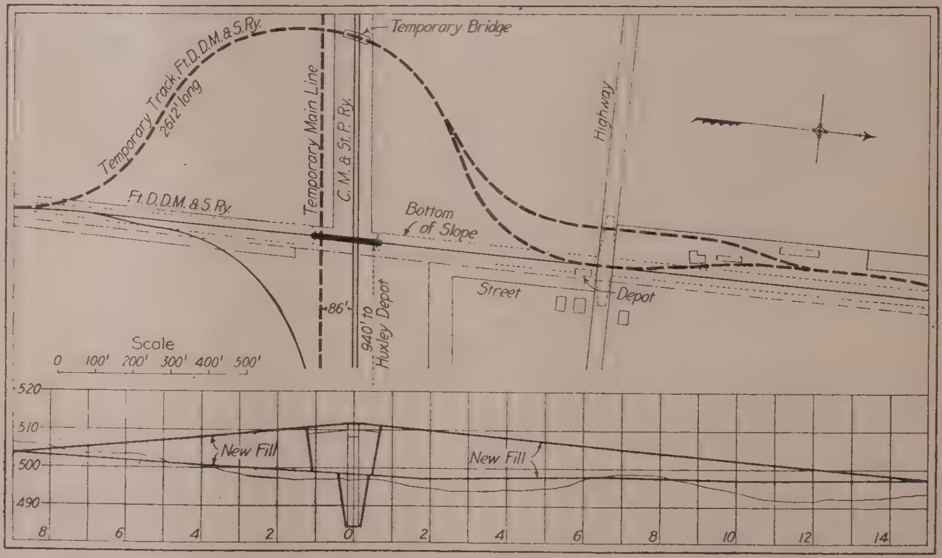
"5. Participate in public affairs, not only to discharge your political and social duties, but also because of the development and breadth of view that will come to you.

"6. Finally, be courageous, have an ambition for a large success, and then work hard to attain that goal. May abundant success crown your efforts, and real joy attend you through a long and useful life."

Grade Crossing Eliminated Without Halting Traffic

Short Detour Enables Chicago, Milwaukee & St. Paul to Lower Track at Huxley, Iowa, While Intersecting Line Is Raised

AS A RESULT of grade changes at Huxley, Iowa, on the Chicago, Milwaukee & St. Paul Railway, in connection with its Iowa double-track work, the engineers of that company were confronted with the problem of lowering their grade 13 ft. and at the same time allowing the Fort Dodge, Des Moines & Southern Railway, an electric system with frequent train service, to be raised 12 ft. without interfering with traffic on either line.



LOCATION OF DETOUR, AND OLD AND NEW PROFILES OF ELECTRIC LINE

In carrying out the excavation of the Huxley streets and the Fort Dodge line, it was necessary for the steam shovel to make four cuts at each crossing. Owing to the frequency of trains on the electric line the following track scheme was laid out to prevent interference with traffic on either line.

TRACKS LAID IN EFFECTING CHANGE

A temporary main track for the Chicago, Milwaukee & St. Paul was laid to the south of its cut. Next the Fort Dodge, Des Moines & Southern laid out a temporary main-line track crossing the Chicago, Milwaukee & St. Paul 600 ft. west of the permanent crossing of the two lines. The four curves making up this track were dubbed the "derby hat" detour. The distance from the brim to the crown was necessary in order to obtain tail room for the steam road's construction trains to work in without crossing the electric road.

Bridge material was assembled on the ground, and when the St. Paul's steam shovel had cleared the permanent crossing with its last cut, a temporary bridge was erected behind the shovel. The traffic on the interurban was then changed back to the main line and the track taken up at the temporary crossing. The St. Paul's cut was then finished west of the crossing, completing the excavation for a new double track. While the tracks were being laid and ballasted, the electric line's traffic was again diverted to the "derby hat" detour which it was necessary now to carry over the double-track excavation on a temporary timber bridge. The electric railway company's main line was then taken up, after the piles had been driven for the new bridge over the steam road's new double track. The approaches to the new bridge were graded and the main track was relaid and ballasted. When this was finished and one of the Chicago, Milwaukee & St. Paul's permanent main tracks was ready for service, a force of track and bridge men was assembled and in one hour, without interfering with traffic on either line, track connections were made, stringers were placed on the electric line's bridge where it crossed over the Chicago, Milwaukee & St. Paul's temporary track, and the temporary trestle of the interurban over the steam road's main tracks was removed. It was also necessary to remove two temporary street bridges and finish the permanent street bridges by erecting a span over the abandoned temporary track, indicated in the accompanying drawing.

The grading was done by the Walsh Construction Company, of Davenport, Iowa, but all of the bridge work was done by the bridge department of the Chicago, Milwaukee & St. Paul Railway. E. L. Sinclair was the assistant engineer in charge of the work, reporting to W. E. Wood, district engineer.

Literature

For the Civil Engineer and Contractor

New Publications

The Municipal Engineers Journal, May 1915. Paper; 6 x 9 in.; 123 pages; illustrated. New York, The Municipal Engineers of the City of New York. 50 cents per copy, $4.00 per year.

The first issue of a new publication inaugurated by the publication and library committee of The Municipal Engineers of the City of New York. Contains reports of committees and society notes, and two papers, with discussion, "Some Problems of Street Paving in Large Cities," by Henry Welles Durham, and "The City Controlling the Development of Private Property," by George B. Ford.

The Flow of Water in Irrigation Channels. By Fred C. Scobey, irrigation engineer. Bulletin 194, U. S. Department of Agriculture. Paper; 6 x 9 in.; 68 pages; illustrated; tables and diagrams.

Contains the results of experiments made under irrigation conditions and in channels of modern construction for the purpose of determining the proper constants or retardation factors in Kutter and Chezy formulas. Describes the necessary field data for computing these values and the required equipment and methods. Gives estimation charts and recommended values for different kinds of channels.

Report of the Tests of Metals and Other Materials Made with U. S. Testing Machine at Watertown Arsenal, Mass., 1914. Cloth, 6 x 9 in.; 217 pages; illustrated. Washington, Government Printing Office.

Annual report for the fiscal year ended June 30, 1914, of various tests made during the year under the direction of C. B. Wheeler, commanding officer, Watertown Arsenal. Among the more important series of tests were the following: Hydrostatic tests of shrapnel cases; shock, tensile, hardness and warpage tests of shrapnel-case metal; resistance tests of rotating bands in mortars; tests of three small steel columns with pin ends; tests of chains; friction test of bronzes; tensile tests of wire rope and Manila rope; proof stresses in piston rods; compressive tests of springs and various impact tests. Experiments on heat treatment of steel, including physical tests and metallographic examinations, are detailed.

A Primer on Explosives for Metal Miners and Quarrymen. By Charles E. Munroe and Clarence Hall. Bulletin 80, Bureau of Mines. Paper; 6 x 9 in., 125 pages; illustrated. Washington, Government Printing Office.

Deals with the extensive experiments made by the Federal Bureau of Mines to increase the safety of miners working in metal mines, and supplementing the account of experiments made with the different explosives used in coal mining, as given in Bulletin 17. Gives full explanation and description of combustion, different methods of causing the explosions and relative dangers. Blasting and mine explosives; fuse, detonators and electric detonators; firing blasts by electricity; the use of explosives in excavation work, in quarrying, and in metal mining and tunneling; drilling and blasting methods in various modern tunnels; and magazines and thaw houses are discussed in some detail. Permissible explosives for both coal mines and metal mines are given, and the requirements for tests as outlined by the Bureau of Mines. Federal law and Interstate Commerce Commission regulations governing the shipment and storage of explosives are concisely stated, and a list of previous Government publications on allied subjects included. Good illustrations illumine the text.

U. S. Geological Survey Bulletins. Paper; 6 x 9 in. Washington Government Printing Office.

Results of Spirit Leveling—In Idaho, 1896 to 1914 inclusive, Bulletin 567; 130 pages; tables.—In Minnesota, 1897 to 1914 inclusive, Bulletin 560; 190 pages; tables.

Stream Gauging Stations and Water Resources—Western Gulf of Mexico Drainage Basins, Water-Supply Paper 340-H; 9 pages.—Colorado River Basin, Water-Supply Paper 340-I; 11 pages.—The Great Basin, Water-Supply Paper 340; 12 pages.—Niles Cone and Adjacent Areas in California, Water-Supply Paper 345-H; 41 pages; illustrated.—Surface Waters of Iowa, Water-Supply Paper 345-I; 52 pages.—Ground Water for Irrigation in the Sacramento Valley, California, Water-Supply Paper 375-A; 49 pages.—Ground water in Southeastern Nevada, Water-Supply Paper 365; 84 pages; illustrated.—Tularosa Basin, New Mexico, Water-Supply Paper 343; 317 pages; illustrated.—Underground Waters of the Coastal Plain of Georgia, Water-Supply Paper 341; 539 pages; illustrated.—Surface Water Supply of St. Lawrence River Basin, 1913, Water-Supply Paper 354; 136 pages; illustrated.—Surface Water Supply of Ohio River Basin, Water-Supply Paper 353; 264 pages; illustrated.

The Production of Sand-Lime Brick in 1914; Mineral Resources of the U. S., Part II, No. 1; 7 pages.

Building Code Recommended by the National Board of Fire Underwriters—Fourth Edition Completely Revised, 1915. Flexible cloth; 5 x 7½ in.; 326 pages; illustrated. New York, National Board of Fire Underwriters.

This revised edition contains three new features; the uses of numerous notes scattered through the text to serve as recommendations, cautions or explanation, the introduction of cuts illustrating details of construction, and the use of frequent cross references for finding allied subjects.

The new edition also contains, among other changes, a broader application of the table covering allowable floor areas with and without sprinklers and more generous allowance for efficient protection; a treatment of the subject of exits on the new basis of number of occupants instead of floor area; the recommendation of smoke-proof towers and outside stairways to replace all fire-escapes; an appendix containing new grading rules for timber and new allowable loads on timber beams; specifications for fire tests and methods for loading tests; general requirements for certificates of occupancy; regulations for roofings with the object of eliminating inflammable materials; provisions for new materials and hollow building blocks, and the complete revision of the engineering and fire protection features of the code.

Books Reviewed

Who Started the Panama Canal and Its Railroad?

Author, Charles E. A. MacGeachy. Paper, 11 x 8 in.; 24 pages. New York, M. B. Brown Printing & Binding Company. 25 cents.

In this pamphlet Mr. MacGeachy tells the story of the survey for a railroad and a canal across the Isthmus of Panama in 1845 by his father, Col. Edward MacGeachy of the Royal Engineers. Knowledge of this survey has, apparently, not come to the notice of most of the writers on the history of the Panama work.

It appears that Colonel MacGeachy conceived the scheme of connecting the two oceans with a canal and a railroad and received some encouragement from the British Government for making the surveys. He was then crown surveyor of the Island of Jamaica, West Indies, and, being provided with an escort by the Government, undertook the work. He unsuccessfully laid his surveys and recommendations for a railroad—to be followed later by a canal—before the English authorities. He then took up the matter with Prince Napoleon—later Emperor Napoleon the Third—who became enthusiastic over them. However, there were no immediate results, and the surveys, so Mr. MacGeachy declares, finally passed on to DeLesseps, who used them as a basis for his work.

Report on Collection and Treatment of Philadelphia's Sewage

Prepared by Bureau of Surveys, George S. Webster, chief engineer; George E. Datesman, principal assistant engineer, and W. L. Stevenson, assistant engineer. Cloth, 6½ x 9¼ in.; 188 pages; fully illustrated with maps, diagrams and photographs.

The report on the comprehensive plan for the collection, treatment and disposal of the sewage of Philadelphia, embodying the results of work begun in 1907, was issued last week. It is a noteworthy volume, not merely because it outlines plans involving the expenditure of $34,600,000 to provide for conditions in the year 1950, but because it illustrates in a convincing manner how such a report should be prepared. At the very beginning there is a concise statement of the problem and its solution, so that before the reader enters into the details of the report he has a well defined idea of what it is all about. Too much praise cannot be given to George L. Webster, George E. Datesman and W. L. Stevenson for this evidence of an appreciation of the reader's needs—a point which most engineers neglect entirely in attempting to tell of their work.

The report does not go into details of design but presents the general features of a system of intercepting sewers and three treatment works. Two of these include coarse screens, grit chambers and Imhoff tanks, with future provision for sprinkling filters, while the third provides only for clarification by screens and grit chambers. A definite program of construction in successive stages is mapped out.

A valuable portion of the report is the discussion of progress in the art of sewage treatment, in which all of the various processes are described. There are appendices on Philadelphia's existing sewerage system, on the sanitary surveys of the Delaware and Schuylkill Rivers, and on Mr. Datesman's inspection of European treatment works.

To the sanitary engineer's library the Philadelphia report will be a welcome addition, and for the engineer who knows nothing of sewage treatment the volume can well be studied as a model of the form in which engineering data on a large project should be presented.

Railroad Field Manual for Civil Engineers

Author, William G. Raymond, C.E., L.L.D., professor of civil engineering and dean of the College of Applied Science, State University of Iowa. Leather, 5 x 7 in.; 386 pages; 31 illustrations. New York, John Wiley & Sons, Inc. $3 net.

Reviewed by A. F. Comstock

Associate in Railway Engineering, University of Illinois

Two essential departures from the standard railroad field book have been undertaken in this work: (1) The decimal division of the degree has been used instead of minutes and seconds, and (2) the text has been reduced to the point of serving almost exclusively to explain the use of the tables.

The author's aim has been to provide a book for field rather than for office use. One's first impression is likely to be that the book might properly have been designated "Tables for Railroad Engineers," instead of "Railroad Field Manual," since the tables comprise 327 pages of the total of 386, leaving only 59 pages for the text matter, including the index. There appears to be but slight justification for the term "manual" (in its accepted sense), as the text of the eleven chapters is used in most cases only as an introduction to the tables. The chief exceptions to this statement are Chapter 1, "Simple, Compound and Vertical Curves" (11 pages) and Chapter 10, "Adjustment of Instruments" (4 pages).

The tables are exceptionally complete, there being 83 in all. Five-place logarithms are used; and logarithmic functions are given both for degrees and hundredths of a degree, and for degrees and minutes. The tables of radii, tangents, tangent corrections, middle ordinates, etc., are computed for decimal divisions of the degree instead of for minutes. There are seventeen tables on the ten-chord spiral, and seventeen on earthwork. Three tables of the more commonly used functions of metric curves, comprising five pages, are given; and there are several tables relating to train resistance and tractive effort, besides several others not commonly found in book form.

The author deserves credit for promulgating the decimal division of the degree to the point of risking the success of his book on that issue. The idea is a progressive one, and undoubtedly will continue to find converts.

The book is not likely to appeal to railroad engineers except through its numerous tables, and even from this standpoint those who are not yet ready to change to the decimal division of a degree will find it of limited use. The exclusion of many of the typical problems in curves, turnouts, crossings and connections militates against its usefulness in the field, while the abridgment of the text unsuits it for general application in the classroom. The binding and typography evidence a high standard of book-making.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Activated Sludge and the Baltimore Sewage Experiments

SIR: I have read with great interest your article in the Engineering Record of April 24, 1915, page 521, relative to activated sludge experiments at Baltimore. Last August the writer had the privilege of visiting Manchester and Salford and saw the apparatus used for the original experiments by Ardern and Lockett in Manchester and saw the Salford tank in operation.

G. J. Fowler, of Manchester, was most enthusiastic about the new process and had then thoroughly realized the advantages of a continuous-flow method over a fill-and-draw method. He had already tried experiments on a small scale to develop the continuous-flow plan of operation but had not been successful on account of the necessary agitation of the sewage, which caused portions of the sewage to pass through the tank very much more rapidly than the average detention period, depriving it of the necessary contact with the activated sludge.

It would seem to the writer that some form of tank might be designed which would contain a great number of vertical baffles or walls, which would absolutely prevent any cross currents or short circuiting, and which would subject the sewage between each pair of walls to a known and definite amount of aeration for a definite period. It would seem that such a tank could be planned with a velocity of sewage between diaphragms sufficient to keep the sludge in suspension, thus permitting an economy in the quantity of air used. The sludge which would be carried forward by the flowing sewage could be intercepted at the end of the series of baffles and pumped back so as to discharge into the upstream end of the tank.

The writer has made no attempt to work out structural or hydraulic details of the scheme above outlined, believing that such detailing could better be done by those in charge of the experiment, who are familiar with the existing facilities and limitations.

CHARLES E. GREGORY,
Engineer-in-Charge of Sewers,
Borough of Manhattan.
New York City.

SIR: I have your letter in which you inquire about the method of operation of the Pachuca tank. This tank accomplishes its mixing and agitating function by the air going up inside the central tube. The air jets are directed downward from the horizontal for the purpose of general diffusion to prevent the air bubbles from tending to rise in a limited annular ring near the air pipe. The Pachuca tank is a thorough mixing and circulating device as is evidenced by its successful use by J. M. Hartgering for the purpose of mixing slurry at a wet process cement mill. Mr. Hartgering used it on the "fill-and-draw" plan but it seems to me that it could be adapted for use on the continuous flow plan in connection with an aero tank. I had thought of its being used in the Baltimore experiments as follows:

1. Hang an air lift tube from the partition diaphragm, this tube to extend to a convenient point near the bottom of the tank.
2. Insert air pipe to a point near the bottom of the air-lift tube.
3. Allow the sewage to enter through the sludge pipe.
4. By the air lift cause a sewage and sludge mixture to rise through the inner tube and flow over a weir on the inner circle, after which it would deposit the sludge in passing through the sedimentation chamber and flow away over a weir on the outer circle. The sludge would be returned to the sludge chamber through the slot. The suggested adaptation of the Pachuca tank is merely to insure the success of this general scheme of operation and the suggestion is made because there was doubt in my mind as to its success unless some such expedient were adopted.

H. C. MCRAE,
District Engineer, International
Joint Commission.
Detroit.

Creosoted Wood Blocks Suitable for Bridge Floors if Fireproofed

SIR: There has been general and extensive discussion about the disastrous fires and destruction of the steel bridges at Detroit and Vancouver (see Engineering Record, May 15, page 605), due to the burning of the wooden floor systems and creosoted wood-block paving thereon, and the inference has frequently been made that the use of combustible floor and paving systems should be discontinued on steel bridges in order to eliminate the fire hazards. Engineers, in general, have been severely criticized for their frequent failure to provide an incombustible floor system on this type of structure.

In this connection, it is well to study all the conditions carefully before any conclusions are made. The defects in construction which made these disasters possible should be picked out and any recurrence of similar nature obviated, wherever possible, in the future.

In the case of the Detroit bridge, it is now generally believed that the fire was due to defective electric wiring underneath the floor system. It is certain that the fire originated and gained headway from below. In the case of the Vancouver bridge the same thing was true, the fire originating below the floor system, the supposition being that the origin in this case was incendiary. The floor systems of both of these bridges consisted of creosoted wood block laid on creosoted planking, with no fireproof protection underneath. Both of these fires originated and gained their headway on the under side of the floor. It has been demonstrated that creosoted wood blocks are very fire resistant, when laid in street pavements, where they cannot be attacked from below. It would seem from the fact, that the fault in the design of these two bridges did not lie in the fact that creosoted wood block floor systems were used, but in the fact that they failed to provide the floor with fireproof protection on the under side.

It is a fact which, as I stated above, has been demonstrated time and time again that creosoted wood block, properly seasoned, is less inflammable than untreated wood. Baltimore, at the time of the fire, had an experimental section of pavement, consisting of sections of creosoted wood block, granite block, sheet asphalt and vitrified brick in the heart of the fire district. The heat was so intense that the granite blocks which adjoined the wood block section were in a great many places cracked and chipped, the asphalt melted and ran toward the gutter, the vitrified brick chipped, but the creosoted wood block section was only slightly charred on top and was practically undamaged. Steel telephone poles through this same section were warped all out of shape, but the creosoted poles were merely charred and were the only ones left in service after the fire. The same experience was had at Jacksonville, Fla., at the time of the fire in 1901 which destroyed 148 city blocks. Of a line of thirty creosoted poles which the Bell Telephone Co. had through the fire district, only four had to be replaced, the majority being only slightly charred.

With this experience in view, namely, that creosoted wood block pavements and floors are fire resistant to the highest degree, if protected from below, and that creosoted wood, in general, is also less hazardous to use, from a fire standpoint, than untreated wood, it is safe to say that such fires as destroyed the Detroit and Vancouver bridges could not have occurred if the floor system had been protected on the underside by buckle plates or some other fireproof protection, or if the wood-block paving had been laid on concrete slabs.

It should also be of interest to engineers to know that the Bureau of Combustibles of the Fire Department of the City of New York permits creosoted wood-block flooring to be laid in the garages of that city where fireproof construction is considered to be absolutely necessary.

When all the facts in the case are considered, I do not think that anyone could be justified in foregoing the great advantages of this kind of flooring on account of the slight hazard of fire, if the proper precautions are taken against the same in the construction designs.

L. T. ERICSON,
Engineer, American Creosoting Company.
New York.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Scraper Dragged from Extension Boom Cleans Berm of Ditch

By ALBERT S. FRY
Morgan Engineering Company, Memphis

IT often happens in constructing drainage ditches that the depth of cut on part of a particular contract will be greater than that on the remaining part of the work. Where this is the case considerable difficulty is found in leaving clean berms where the deep cut is encountered. If the dredge used is large enough to make the deep cut and leave good berms considerable excess material will have to be moved on the major part of the contract in order to provide width enough to float the dredge. If the dredge is adapted to the ordinary cuts it cannot deposit the spoil at a sufficient distance back from the ditch to leave satisfactory berms.

On a drainage contract in Missouri, it was found that the greater part of the excavation could be handled by a 1½-yd. dredge equipped with a boom 45 ft. long. A part of the work, however, involved a cut of 17.4 ft. Rather than install a large machine and dig excess dirt where the cut was moderate, the smaller machine was used for the entire work. In making a deep cut, no berm was left on the first trip. After the large section of ditch was cut to the proper lines, the dipper, dipper stick and the sheave at the end of the boom were all removed from the dredge. Next, two 8 x 10-in. timbers were clamped on each side of the boom, extending its length about 14 ft. The sheave was then installed at the outer end of these sticks. The pan of a wheel scraper was attached by its front end to the hoisting line and by its rear end to the backing line. The boom of the dredge was then swung at right angles to the boat. With this arrangement, the scraper could be dragged back and forth up the bank, taking a load with each trip out, until all the earth had been scraped off of the original ground surface to the required width of berm. Two men were employed in holding the scraper. The material was moved quite rapidly. This work was done by Emmett Wills, a contractor of Paragould, Ark.

Drill Outfit for Light Blast Holes and for Rock Soundings

A SIMPLE rig has been in use for sometime for finding rock surface, to a maximum depth of 30 ft., along the line of the Welland Ship Canal. The same device has been used on the St. Peter's Canal, Nova Scotia, for blasting hard pan in front of a steam shovel.

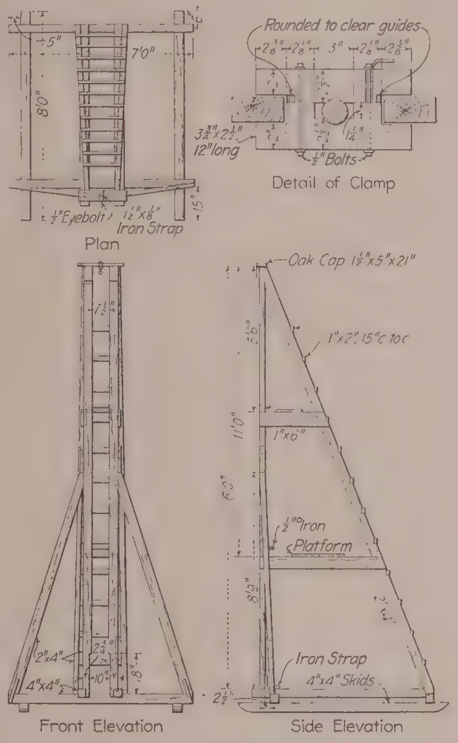
It consists of a light frame for operating a 125-lb. hand-raised hammer. The drill rods are of two types; 12 and 20-ft. rods with solid points, for drilling where the rods can be withdrawn without much trouble by the use of a jar weight, and rods with removable points for both 12, 20 and 30-ft. depths. Details of rods, hammer, jar casting and frame are clearly shown in the accompanying drawing. It has been found of late, however, that rods of 1½-in. diameter are heavy enough.

The clamp, it is apparent, is used near the top of the rod to hold it in place to receive the blow of the hammer. In order that it may be quickly placed and removed one of the holding bolts passes through a slot. By releasing the nut the adjacent side of the clamp can be rotated around the other bolt. The corners of this side of the clamp are therefore rounded to clear the guides.

HARD PAN DRILLED WITH LIGHT DRIVING OUTFIT ON ST. PETER'S CANAL

The jar casting is used for removing rods, taking the place of the hammer.

For the greater depths difficulty is found in removing the rods with solid points. For that reason cast-iron sleeves are used for the deeper and more difficult drilling, the sleeve, of course, remaining in the ground. The sleeves have cost about 7 cents each.



LIGHT LEADS OF DRILL OUTFIT BUILT TO DRIVE AND PULL SOUNDING RODS

On the Welland Canal work this outfit was operated by four men, who were able ordinarily to drive four 20-ft. tests through very stiff clay in a 10-hour day. The frame with hammer weighs approximately 365 lb. and was moved about by the operating gang.

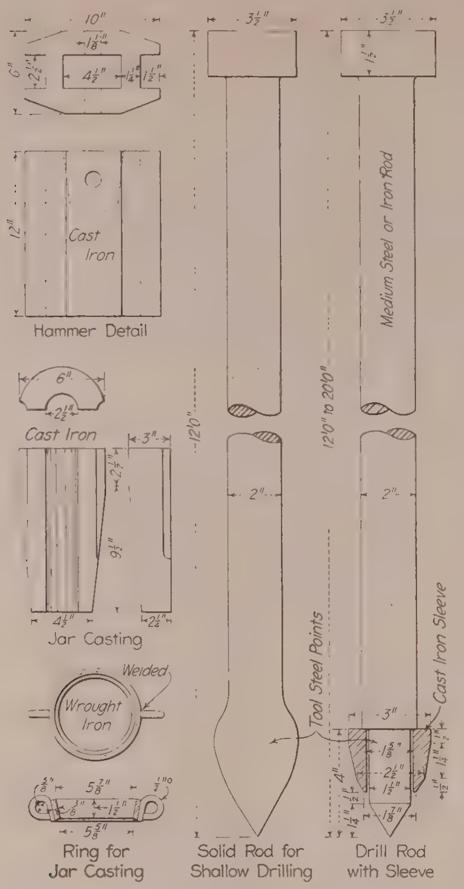
The following table gives an idea of the work done by one of these machines in testing foundations in stiff clayey material where the drill passed through hard material into soft.

USED FOR BLAST HOLES

On the St. Peter's Canal, in Nova Scotia, the same rig was used by W. H. Weller,

NUMBER OF BLOWS AT DIFFERENT DEPTHS DRIVING THROUGH STIFF CLAY INTO SOFTER MATERIAL

Depth, feet	Blows	Depth, feet	Blows
1	9	16	20
2	11	17	30
3	12	18	24
4	9	19	32
5	9	20	34
6	12	21	44
7	23	22	50
8	29	23	50
9	30	24	30
10	34	25	44
11	31	26	47
12	27	27	15
13	21	28	13
14	21	29	17
15	18	29½	8



DETAILS OF DRILL RODS AND HAMMER FOR LIGHT SOUNDING OUTFIT

contractor for the enlargement of this work. It was found impossible to make headway without blasting the hard pan. Five men were then put on one of these outfits and after a little experience found no difficulty in keeping ahead of the shovel, doing all the drilling, loading and blasting. Holes were drilled to a maximum of 20 ft., sprung when the material was especially compact, and then loaded. In lighter material and shallow depths, springing was not necessary.

The progress in stiff clay on the Welland Canal when putting down 20-ft. holes was noted above. For shorter holes the progress is greater. On the St. Peter's Canal enlargement the crew has drilled 120 ft. in 10 hours in 10-ft. holes. The material was hardpan filled with boulders. This was done with the solid-point drills, which means that the drill had to be driven out as well as in. If the removable points had been used for these short holes, the results would have been much better.

The outfit was designed by J. L. Weller, engineer-in-charge, Welland Ship Canal. It was his son who used the apparatus on the St. Peter's Canal.

Effective Grout-Mixing Rake

A SIMPLE and effective grout-mixing rake is in use by the Lock Joint Pipe Company, of New York. It consists merely of a rectangular frame, made of a piece of reinforcing bar, supporting a piece of triangular or other wire mesh. The advantage in this open-work type of rake is that it cuts through the mixture, at all times travels along the bottom of the mixing box and thus secures intimate incorporation of the cement with the sand. Experience has shown that a uniform mixture can be secured more rapidly with its help than with hoes.

The rake was designed by J. C. Mitchell, general superintendent of the Lock Joint Pipe Company.

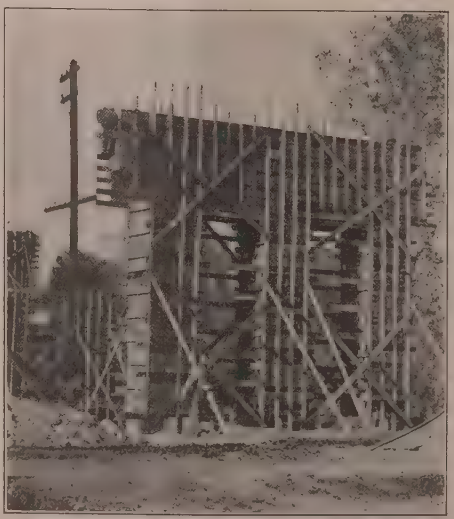
Nothing Heavier than Two-by-Four Used for Tall Pier Forms

By R. C. HARDMAN
Civil Engineer, Colorado Springs, Colo.

LIGHT sectional forms were used during the past winter on the construction of large columns for viaduct supports, the features being the absence of large timbers and the usual column form clamps and ties. The columns were combined into piers as shown in the accompanying photograph, and they were connected at the top by semicircular arches 7 ft. 3½ in. in span. There was also a quarter-circle corbel with a radius of 2 ft. at each end of each pier. The piers constructed with these forms were fifteen in number, eleven having columns 4 x 4 ft. in plan, the other four having 4 x 5-ft. columns. Of the fifteen sets of columns, or piers, nine were rectangular in plan, the other six being skewed at an angle of 5 deg. 43 min. The highest piers were 31 ft., and were poured continuously.

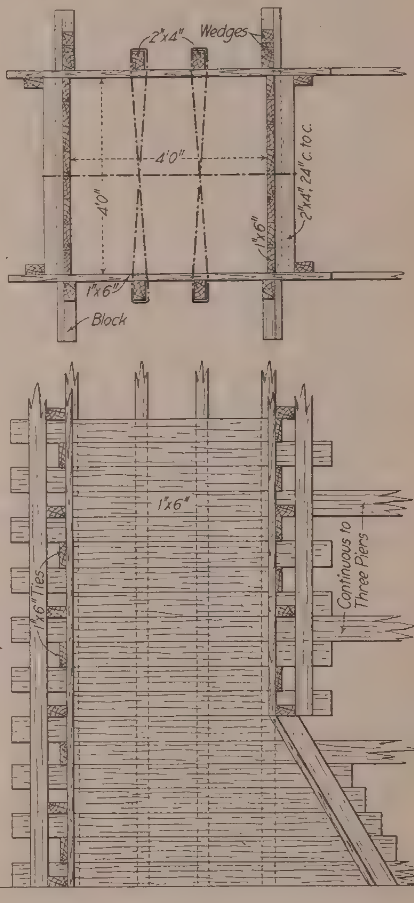
The forms, which were sectional, are illustrated by the photograph and sketch. As the essential feature in the form design, the lagging on the side sections is staggered over the face of each column in the set, every fifth plank reaching continuously across the set of three columns to form a tie. These sections were built three together, flat on the ground, stood up and tied together, and the six end sections built between them. Ties built up with a 2-in. block on each end of the plank, securely nailed, were used in the end sections to hold the side sections together. These ties were slipped through the open spaces made by the flush ends of the lagging and the stay, as shown in the sketch. The block on one end of the tie was fitted against the studding of the side sections, the other block being wedged against the studding on the opposite side of the form. To make the forms more secure ties of black No. 9 wire were used, staggered on 24-in. centers.

All sections were easily transportable with the exception of the side sections, which, when lowered from the finished pier, were divided by pulling off the continuous strips of lagging and making three small sections of each large one. The lagging taken off was plainly marked, so that when the side form was to be used again the boards could be replaced in the same position they had before occupied.



LIGHT FORM STANDS CONTINUOUS POUR

It is believed to be rather unusual in forms of this size and height to use no timber heavier than 2 x 4-in., especially when continuous pouring is done. In spite of continuous pouring, however, no serious bulging was noted, except in one case where brittle galvanized wire ties were used instead of the tough, annealed black wire. On the breaking of a wire twist, the studs of one end section deflected about an inch at the middle.



FORM FOR ONE PIER OF BENT

ANOTHER CONCRETE RECORD of 322 cu. yd. placed in eight hours by a ½-cu. yd. mixer was made at Balboa, Canal Zone, on April 19, according to the Canal Record, in concreting the south wall of dry dock No. 1. The mixer was one of four, normally operated in pairs. Its mate was out of order on this day, and both crews, numbering twenty-nine men and one subforeman, were doubled on one mixer. The total labor cost was $34.87, or 10.8 cents per cu. yd. Labor on this work, however, is only paid 13 cents an hour. Delays amounted to one hour and forty-five minutes, so that the concrete placed per hour of working time was over 51 cu. yd. measured in the form. The mixer turned out seventy-nine batches per hour while running, as each batch in place averaged slightly over 0.65 cu. yd. It is estimated that during this running time each of the eighteen men engaged in wheeling aggregate to the mixer must have handled 147 lb. of gravel per minute.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Town Becomes Contractor

Bidding against sixteen contractors the town of Southampton, Long Island, has been awarded the contract for the construction of 10½ miles of State-aid road between Quogue and Southampton. The town's tender amounted to $113,068, while the contractors' bids ranged from $114,209 to $152,582. The cost of the work will be borne in the proportion of 65 per cent for the State and 35 per cent for the county of Suffolk.

Tunnel Fire Closes Southern Pacific Main Line for Three Weeks

Fire in the timber lining of Southern Pacific main-line tunnel 15 near Tehachapi, Cal., May 14, burned out the wooden supports to such an extent that the entire tunnel caved in. After careful examination the engineers estimated that it would require six weeks to re-open the tunnel for traffic. This was considered too long a closure for so important a part of the system, and hurried calculations as to the possibility of constructing a shoofly were made.

The shoofly involving the least amount of construction called for a 400-ft. trestle 90 ft. high and a cut 70 ft. deep through granite. It was believed, however, that this work could be rushed through in about three weeks, and a large force of men working in three 8-hour shifts was immediately assembled. After eight days had elapsed the engineering department reported, on May 27, that the trestle would be ready in four days, but that 12 or 13 days more would be required to complete the heavy granite cut.

New Jersey Towns Consider Joint Water Supply Project

A plan for developing the Wanaque watershed in New Jersey for the joint use of East Newark, Glen Ridge, Nutley, Harrison and Kearney, is being discussed by representatives of the several municipalities and the State Water Supply Commission. According to the plan outlined by Morris R. Sherrerd, the commission's consulting engineer, the municipalities entering into the plan must, upon notice from the State commissioner, pay to the commission in instalments as may be agreed upon, $200,000 for each million gallons of daily supply contracted for. The $200,000 for each million gallons daily being a capital expenditure, the municipalities must also agree to pay for a consumption equal to at least half the amount contracted for, at the rates fixed by the State commission. Payments shall be made quarterly. The contract will take effect only if a sufficient number of municipalities join in the plan.

Chicago Passes Ordinance Regulating Operation of Motor Trucks

Motor trucks are now regulated in Chicago, as to speed, size, capacity, weight of load, equipment and width of tires, as a result of an ordinance recently passed by the city council. Hereafter no motor truck is allowed to be loaded beyond a maximum gross of 30,000 lb. for the vehicle and load. The weight per inch of tire width is limited to 1000 lb. The overall dimensions may not exceed 8½ ft. in width or 40 ft. in length.

The speed regulation is the same as now exists for other vehicles, except that when the truck has a defective tire which tends to cause injury to the pavement or additional noise the speed is limited to 4 miles per hour. Loads are prohibited from projecting more than 4 ft. beyond the rear of the body except between the hours of one-half hour before sunrise to one-half hour after sunset, and then appropriate danger signs and signals are required. Motor trucks are also prohibited from towing any other vehicle except such vehicle as is accidentally disabled, and in that case the connection between the truck and the other vehicle shall not exceed 16 ft. Violation of the law which goes into effect Nov. 5, 1915, carries a penalty of $100.

Scow's Dynamite Cargo Explodes Causing $40,000 Damage

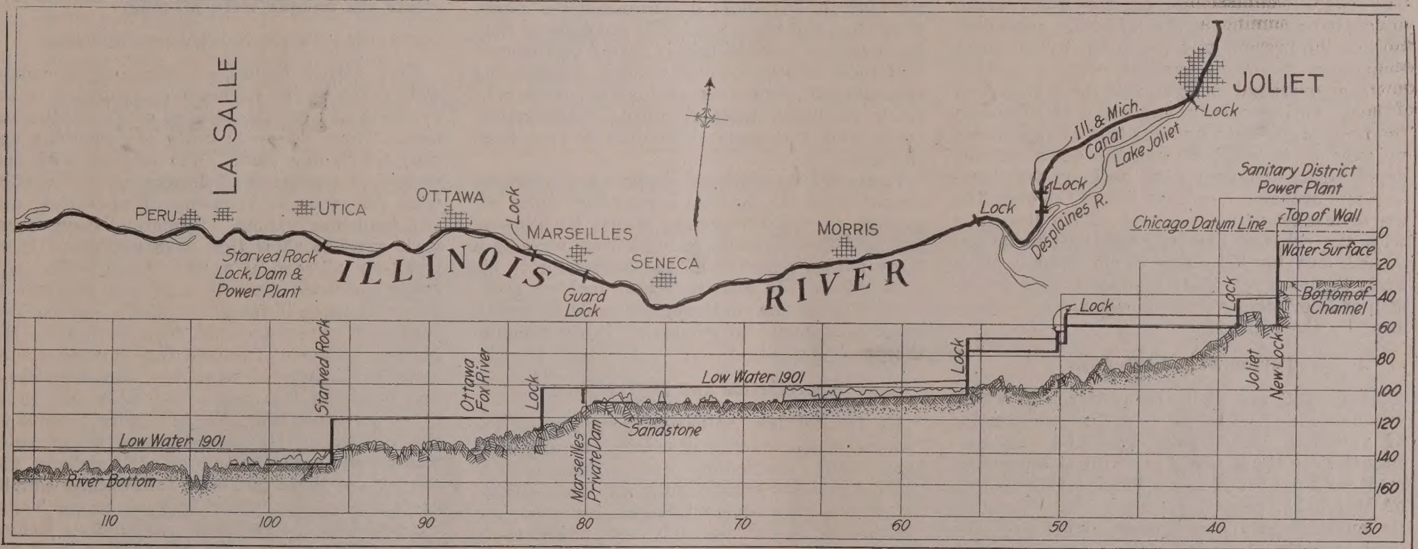
Fifteen tons of dynamite stored on a scow in Seattle Harbor, awaiting shipment to Vladivostok on the steamer "Hazel Dollar," exploded at 2 a. m., May 30. An unknown man employed May 29 as watchman is missing and it is feared that the explosion may not have been accidental. Officials of the Dollar Steamship Company report that the shock was felt within a radius of 35 miles and that the damage to plate glass windows in Seattle will amount to about $40,000.

Illinois $5,000,000 Waterway Plan Now Assured

Governor Dunne Will Appoint Commission in July —Expect to Finish Work in Two Years— Route to Be Followed

Indorsed by both houses of the Illinois Legislature and backed by the Governor, the Illinois waterway bill, providing for the expenditure of $5,000,000 for 65 miles of 8-ft. waterway from Joliet to Utica, is now assured. Members of the Illinois Waterway Commission, authorized under the bill, will be appointed by Governor Dunne immediately after July 1, at which time the measure will become a law.

Under the terms of the bill the commission will be composed of five members, including three from the majority party and two from the minority party. The chairman is to receive a salary of $6000 a year, while the other four members are each to get $5000. One of the members of the commission is to be a civil engineer. An attorney, chief engineer, secretary and other employees will be named by the commission, creating a large amount of patronage, which will be under the control of the Governor.



NEW 65-MILE $5,000,000 CANAL IN ILLINOIS WILL IN GENERAL FOLLOW ILLINOIS RIVER—WILL HAVE SEVEN LOCKS

Edward J. Kelly, of Chicago, new assistant chief engineer of the sanitary district and one of the engineers responsible for the waterway plan, is considered to be certain of appointment either as a member of the commission or as chief engineer.

Route to Be Followed

Starting from Joliet, where the sanitary district canal comes to an end, the proposed waterway is to follow the route of the old Illinois & Michigan Canal for a distance of 15 miles to Dresden Heights. In case pending litigation involving a privately owned dam site at Dresden Heights is decided favorably to the State, the bill provides that the Des Plaines River instead of the canal shall be followed. From Dresden Heights to Utica the waterway will follow the Illinois River, except for a distance of 3 miles at Marseilles, where a new channel will be dug in order to get around the privately owned dam at that point. From Utica south to the Mississippi the Illinois River now is navigable.

It is expected that surveys can be made this Summer and the work completed within two years.

Railroad and Public Officials Discuss Federal Valuation in Three-Day Conference

State Commissions Disagree Radically with Railroads on Knotty Problems, and Latter Are Not Wholly Consistent in Their Theories

That the State railroad commissions disagree with the railroads on almost every debatable point concerning railroad valuation, and that neither the commissions nor the railroads have their theories positively allocated in every detail, were two impressions made by the conference conducted in Washington last week by the Division of Valuation of the Interstate Commerce Commission. In general the railroads made the claims upheld by this journal, that in the reproduction method the original topography but present environment, construction methods and prices should be assumed; that historical construction necessities should be assumed, and that ample overhead charges should be allowed; that appreciation should be allowed for, but that depreciation should be deducted only where service has been impaired, and that the land should be valued at the prices the railroads would probably have to pay now to reproduce their right of way. The State commissions, on the other hand, advocated assuming a straightaway reproduction of the present physical plant by the most economical program possible, with a scaling down of overhead charges and the elimination of such contingencies as could now be foreseen; the ignoring of such appreciation as represents no expense or sacrifice, and the deductions of depreciation strictly on the basis of deterioration and probably length of life of the unit; the use of market values for land. They disagreed with the railroad idea of conditions to be assumed, but hardly made it clear what their basic theory was. They also advocated exclusion of five "other values or elements of value" cited by the railroads.

Personnel at Conference

About 250 attended the conference, which was held May 27-29, with C. A. Prouty, director of valuation, presiding. The questions discussed were those given in the first announcement, and published in the Engineering Record of March 13, page 324. Each side presented its answers to the questions, but there was little rebuttal. Thomas W. Hulme, general secretary of the Presidents' Conference Committee, was the general spokesman for the railroads, calling on various legal and engineering representatives of the carriers to discuss the individual questions. Milo R. Maltbie represented the State commissions. Mr. Hulme was given until June 15 to file a brief expanding the railroads' views, and Mr. Maltbie was given an additional week to reply.

The first question had to do with the character of report of valuation to be made by the Division of Valuation and by the Interstate Commerce Commission. The railroads urged that the reports be complete and truly evidentiary. The State commissions asked for further time to discuss the matter.

Conditions to Be Assumed

The conditions to be assumed in determining cost of reproduction new were discussed mainly by E. Holbrook, special engineer of the Union Pacific. He advocated that original necessary expenses, such as clearing and grubbing, and the removal of buildings, be assumed, but that present development similar to that alongside the right of way, such as the planting of orchards, be allowed for. Mr. Maltbie's view was the reverse of this, that no allowance for the orchards should be made, and that clearing and grubbing should be allowed only if present surroundings showed that it would now be necessary.

W. L. Seddon, assistant to the president of the Seaboard Air Line, discussed the question of whether the road should be reproduced in the form and manner it was originally built. He thought the original form and piecemeal construction should be followed, but with modern equipment and at present-day prices. Materials he would get from the easiest source, if they were as good as those originally used. To get "reproduction cost new" he would figure new rail even where re-lay was used. The State commissions would disregard both original form and original manner, and follow the most economical program possible. Where re-lay rail was used they would figure re-lay rail.

Overhead Charges

Engineering was discussed by Charles Hansel, who gave a figure of 7.2 per cent for the New York terminal of the Pennsylvania, and 7.6 per cent, including land, on New York Central, Barge Canal and other work aggregating $250,000,000. He advocated a minimum of 5 per cent, exclusive of land. He thought 2 per cent a good figure for engineering on equipment. Discussing contingencies, Mr. Holbrook cited actual instances of unforeseeable conditions that had made work cost much more than the estimate, and thought it should be assumed that these or others would occur in reproducing any railroad. Other representatives of the railroads discussed interest during construction, taxes and the general subject of overhead charges.

In discussing overhead charges for the State commissions Mr. Maltbie agreed that those not covered in the unit prices should be allowed, but held that in contract work they were to a large extent assumed by the contractor in his unit prices. He also held that looking backward most of the contingencies could be anticipated and should be eliminated in reproducing the present plant.

Appreciation and Depreciation

H. C. Phillips, valuation engineer of the Santa Fé, argued for allowance for appreciation, both adaptation and adjustment to economical operating conditions, and solidification and seasoning with time and use. Mr. Maltbie held that the only adaptation to be allowed was what would automatically be included as additions to the property, and that solidification, representing neither expense nor sacrifice, should be ignored. D. F. Jurgensen, engineer of the Minnesota Railroad and Warehouse Commission, argued that in an embankment reproduced new no solidification will have occurred.

Judge W. G. Brantley discussed depreciation at length. He held, as this journal has, that where proper service is given there is no depreciation. In answer to Mr. Prouty's remark that the Valuation Act required deduction according to the deterioration of physical units, he held that the proper unit for track was the track itself, and that as a seasoned track with ties and rails being renewed in cycles was more valuable than it would be if brand-new in all its parts, as it never was at any time, it was unfair to make deductions because most of the ties had lived part of their service lives. He would deduct for any deferred maintenance found. He thought little use could be made of mortality tables or formulas, and that good judgment was necessary in every case to determine what deterioration has taken place. He thought it unsafe to predict future obsolescence or inadequacy.

Mr. Maltbie held that the law would not accept Judge Brantley's theory, and that depreciation must be measured by the deterioration of the parts, with a previous deduction for any deferred maintenance.

G. W. Kittredge, chief engineer of the New York Central, discussing unit prices, cited some of the wide variations in bids, and stated that mere averages, without careful study of the conditions, would fail to produce the proper figure. To be fair to all roads he thought the prices should all be figured as of one date, June 30, 1914. Mr. Maltbie thought average prices should be used.

Land

Land values were discussed by Pierce Butler, who held that present value must be determined on the basis of condemning private property to-day for public use, and that shape, location and continuity of railroad right of way added to the value. The condemnation theory would allow for severance and damages. Mr. Hulme gave figures to show how far railroad prices must exceed ordinary market prices. Mr. Maltbie thought ordinary market prices should govern.

Thomas Cooper, assistant to the president of the Northern Pacific, discussed when lands are owned or used for common carrier purposes. He thought land acquired long in advance for future use should be included, unless the plan for its future use had been abandoned. Mr. Maltbie would include only land in use and necessarily so, or to be put in use in the immediate future.

Discussing original cost, Mr. Hulme thought it of little use unless there were fair records. Mr. Maltbie thought estimates should be made where the records were missing.

Other Values or Elements of Value

Five "other values or elements of value" were given by the railroads as attaching to the property as a whole, because of its productiveness. These were (1) unity of ownership and use; (2) "going value"; (3) location with reference to command of business; (4) location with reference to economy of operation, and (5) franchise values. Numerous court cases were cited to show that each and all of these had been allowed at various times. The railroads conceded that it was not possible to separate these different elements, but insisted that they all existed and must be found. Mr. Maltbie, however, asserted that the cases cited were a mixture of rate, tax, direct-purchase and condemnation cases and were not to be taken as establishing the principles claimed by the railroads. He asserted that going value was merely a recognition of early deficits, and that where these had been followed by equally excessive profits there was no going value. He held that the railroads were merely finding different names for the same thing, and one of his associates announced that he would file a brief opposing all of these intangible values, and also all so-called unearned increments.

Other matters of less direct interest to engineers were discussed, and several questions, such as the treatment of joint facilities, were suggested for future consideration.

American Society Appropriates $10,000 for Committee Work

The following appropriations for the work of special committees were made at a meeting of the board of direction of the American Society of Civil Engineers held in New York City, May 5: On steel columns and struts, $1000; on materials of road construction, $800; on valuation of public utilities, $800; on a National water law, $2000; on stresses in railroad track, $4500; on employment and compensation of engineers, $400, and on floods and prevention, $500; or a total of $10,000.

The matter of the action taken by the society in regard to the licensing of engineers was considered, and it was resolved that it be referred to letter ballot with the recommendation that the previous action adopted be rescinded so that the board may be free to act in the matter as occasion may demand.

The president was authorized to appoint a committee of the board to report upon a revision of the entire constitution of the society, and a report was received from the chairman of the conference of presidents of local associations, together with certain recommendations as to district organization.

Pennsylvania Railroad Completes New Testing Building

The Pennsylvania Railroad has recently completed and occupied at Altoona a building designed exclusively for its testing department, giving this division 41,000 sq. ft. of floor area instead of about 15,000, which it had previously occupied in the shop-office and storehouse building. This department passes on $80,000,000 worth of material per annum. The cost of the examination and inspection amounts to about six-tenths of 1 per cent.

Beside the laboratories housed in the new building other work is carried on in separate structures—such as the locomotive testing shop, the brake-shoe testing division, etc. A new addition to the facilities of the test department is a chemical test car—a fully equipped laboratory on wheels. It is designed especially for the purpose of making tests and inspections of steel rails at the point of manufacture.

Laboratories

The new structure is five stories high, 160 ft. long and 50 ft. wide. The laboratories and their locations are as follows:

Basement—Receiving room for materials, machine shop for repairs to laboratory equipment and preparation of metal test specimens, fire-proof vaults for storage of records and storage room for chemical supplies.

First Floor—Physical laboratories, with separate sections for oil, cement and lagging, hose, rail and miscellaneous tests.

Second Floor—Office, locker and toilet rooms.

Third Floor—Laboratories for water and gas analysis, bacteriology, tests of rubber, photometry and lamp tests and calibration of electrical instruments.

Fourth Floor—General chemical laboratory, with a separate chemical balance room. The central bay is extended upward to form a fifth floor, in which are a photographic studio and dark room. The roof is used for exposure tests.

Equipment

Some idea of the character of the work which must be provided for is afforded by the equipment of the machine shop. It contains two 14-in. engine lathes, one 12-in. lathe, one 24-in. shaper, one 24-in. radial drill, two milling machines for specimens, one 30-in. cold saw, two hack saws and two tool grinders.

The physical laboratory contains five tensile and compression testing machines, one of 1,000,000, two of 300,000 and two of 100,000 lb. capacity.

The test car, when in use, will be moved to a mill where rails are being rolled and chemical analyses will be immediately made of the finished rails. This procedure, it is expected, will avoid the delays which at times occur in the operation of the mills.

The building cost about $150,000, while the equipment of the various laboratories is estimated to be worth $125,000, making the total investment about $275,000.

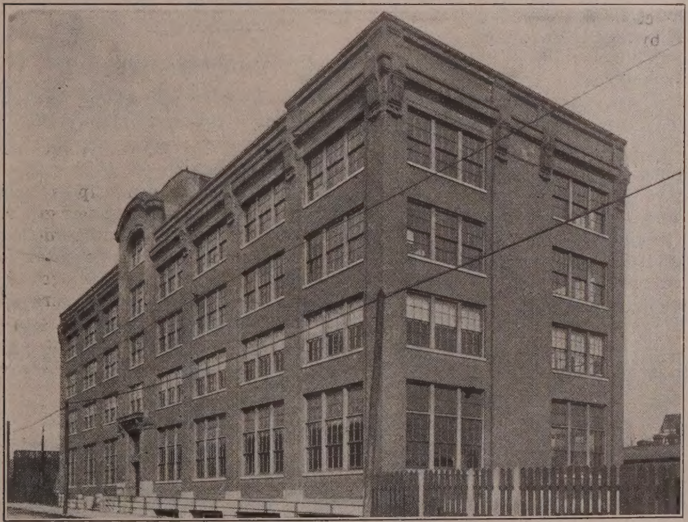
The department is under the direction of C. D. Young, engineer of tests.

San Diego Advised to Buy Volcan Water System and Develop Power

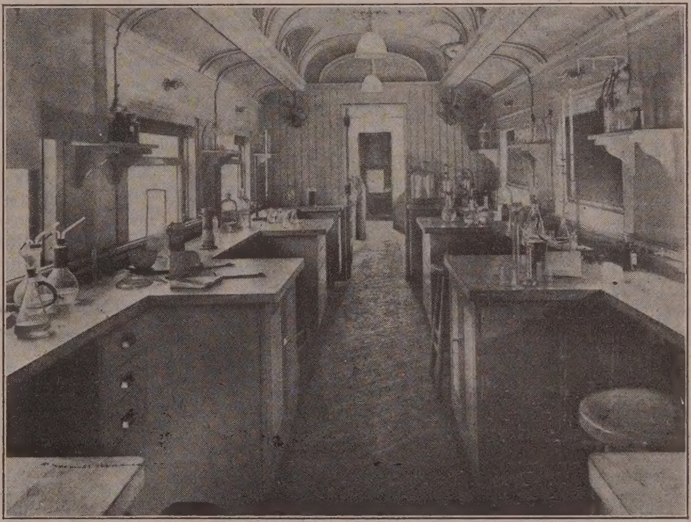
M. M. O'Shaughnessy and J. B. Lippincott recently transmitted to the city of San Diego, Cal., at the request of the city council, a voluminous report on the water system and value thereof which it has been proposed that the city acquire by purchase. The report stated that it would be for the best interests of San Diego to acquire and develop the Volcan water supply system, and placed a value upon the system, in its present undeveloped state, of $2,818,175. An appraisal of the same water supply made by P. H. Harroun, a consulting hydraulic engineer of San Francisco, placed its value at $2,693,000.

In the O'Shaughnessy-Lippincott report, which is a thoroughly detailed and exhaustive statement of the present condition of the water system and its possibilities for profitable development, the recommendations are that the Warner dam be developed for hydroelectric power and that an aqueduct be constructed from this dam to Pamo. The power drop from the end of the Warner aqueduct into Pamo watershed should, according to the report, yield hydroelectric power to give the city a net annual revenue of $30,000. The power to be developed would be approximately 1500 kw. Water can be delivered from this point to the city, it is stated, at the rate of 10,000,000 gal. per day. Development of the entire system would insure a supply of 19,050,000 gal. per day at a cost of 6.84 cents per 1000 gal.

New Building and Laboratory Car of the Testing Department of the Pennsylvania Railroad

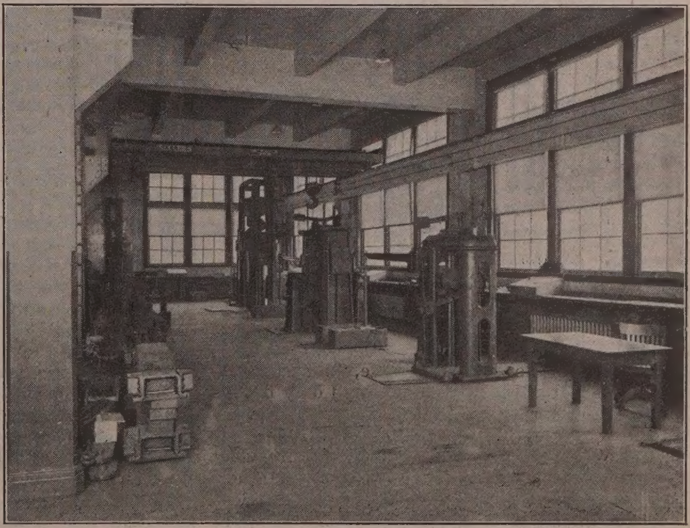


41,000 SQUARE FEET OF FLOOR AREA ARE DEVOTED TO TESTING



THIS LABORATORY CAR IS SAID TO BE THE FIRST OF ITS KIND

AMPLE ROOM IS PROVIDED FOR CEMENT TESTING



THIS LABORATORY CONTAINS FIVE COMPRESSION MACHINES

News of Engineering Societies

The Engineers' Society of Western Pennsylvania heard R. S. Lord, vice-president of the Hope Engineering & Supply Company, of Pittsburgh, speak on "Pipe Couplings" at a meeting held in Pittsburgh, June 1.

The Municipal Engineers of the City of New York will hold a special ladies' night at the Engineering Societies Building, June 9. W. J. Hammer, lecturer for the Wright Brothers, will speak on "Aeroplanes and Airships."

The Engineers' Club of St. Louis heard T. N. Jacob, consulting engineer, of East St. Louis, Ill., speak on "The East Side Levee and Sanitary District," at a meeting held in that city, June 2. Charles M. Talbert, director of streets and sewers, also delivered a short talk on "The Proposed Central Parkway."

The Detroit Engineering Society, in connection with the current discussion in the Detroit Council regarding the proposed bonding of the city to build a new $2,000,000 Belle Isle bridge to replace the structure recently destroyed by fire, passed the following resolution: In the opinion of this society, the design and construction of the new Belle Isle bridge should be directed by a board of bridge commissioners, acting under authority of the proper city officials. Said commission should be composed of five persons, one a mechanical engineer, one a civil engineer, one an architect, one a business man and one a lawyer.

Personal Notes

L. D. Kelsey has been re-elected city engineer of Aberdeen, Wash.

Ezra C. Shoecraft has been reappointed city engineer of Flint, Mich.

J. B. Waud has been reappointed city engineer of Ventura City, Cal.

J. E. Eubank has been appointed city engineer of Brownwood, Texas.

Carl C. Widener has been appointed city engineer of Bozeman, Mont.

Paul Y. Creager has been appointed city engineer of Sherman, Texas.

A. O. Breyer has been appointed city engineer of Mineral Wells, Texas.

Dr. Stephen Taber, professor of geology of the University of South Carolina, has been reappointed to act as State geologist of that State.

David L. Struthers, formerly assistant city engineer of Wilmington, S. C., has been appointed acting city engineer succeeding F. F. Pillet.

Gustave R. Tuska, consulting engineer of New York City, has been appointed lecturer on municipal waste disposal at Columbia University.

George A. Quinlan, Cook County superintendent of highways, addressed the Chicago Association of Commerce June 3 on the subject of "Good Roads."

A. C. Showalter has been appointed assistant superintendent of the Buffalo division of the New York, Chicago & St. Louis Railroad, with headquarters at Buffalo.

G. M. Curry has resigned from the engineering corps of the Vandalia Railroad and has accepted a position with the Whitelaw Brothers Chemical Company, of St. Louis.

W. R. Armstrong, formerly chief engineer and assistant general manager of the Salt Lake City & Utah Railroad, has been appointed chief engineer and general manager.

L. J. Voorhies, formerly city engineer of Lafayette, La., has been appointed assistant field engineer, Department of Valuation, Interstate Commerce Commission, Central District.

H. W. Wright, consulting and supervising engineer, of Winnfield, La., has taken charge of the McGehee (Ark.) Water & Light District as manager, in which capacity he plans to make extensive improvements during the coming year.

Karl M. Mitchell, former village manager of River Forest, Ill., has been appointed village manager of Sherman, Texas, at a salary of $3600. River Forest has discontinued the office.

M. E. S. Posey is chief engineer of the recently incorporated Cumberland & Manchester Railroad, which will shortly begin construction on 23 miles of track between Manchester and Barbourville, Ky.

Ward E. Pearson, son of Dr. F. S. Pearson, will be named to succeed his father as chairman of the board of the Denver & Salt Lake Railroad Company, according to an announcement from Denver.

Charles O. Jenks, general manager of the Spokane, Portland & Seattle Railway, has also been appointed vice-president and general manager of the Spokane & Inland Empire and of the Pacific & Eastern.

D. L. Reaburn, for several years connected with the construction of the Los Angeles aqueduct, is on his way to Washington, where he is to become superintendent of the Rainier National Park, in that State.

J. L. Lancaster, president of the Memphis Union Station Company, Memphis, Tenn., has been appointed assistant to the vice-president and general manager of the Texas & Pacific Railway, with headquarters at New Orleans.

William H. Rochester, formerly assistant engineer and architect to H. Olin Jones, engineer and architect, of Greenville, S. C., has been appointed assistant engineer and draftsman on the valuation work of the Nashville, Chattanooga & St. Louis Railway.

J. L. Gotschall, who was assisting on the survey and plans of the old National Road between Zanesville and New Concord, Ohio, in the service of the State Highway Department, has been transferred to McConnelsville, where he will be engaged on the construction of a section of macadam road, a 35-ft. span concrete slab top bridge and an 80-ft. concrete arch.

R. G. Walter, formerly resident engineer on the construction of the hydroelectric plant for the Wisconsin River Power Company, at Prairie du Sac, is now engaged as assistant engineer in the office of Daniel W. Mead and Charles V. Seastone, consulting engineers, of Madison, Wis., which firm had charge of the engineering work in connection with the Prairie du Sac development.

W. Richmond Tracy, formerly assistant resident engineer on construction of the new line of the Lackawanna Railroad between Scranton, Pa., and Binghamton, N. Y., at Kingsley, Pa., is now connected with the Ohio Service Company as engineer of construction. The company owns several light, heat, power and electric railway properties, which are to be extended and improved.

A. C. Polk, formerly resident engineer and superintendent of construction for Sanderson & Porter, engineers and contractors of New York City, on the hydroelectric development designed and supervised by that firm at Cohoes, N. Y., which was described in this journal March 20, page 352, and March 27, page 395, is engaged in the same capacity on the construction of a new steam power plant at Parkersburg, W. Va., on which Sanderson & Porter are engineers and contractors.

Edward C. Barnard, chief topographer of the International Boundary Commission, has been appointed commissioner for the survey and marking of the boundary line between the United States and Canada. He was graduated from Columbia University in 1884 and entered the service of the U. S. Geological Survey as assistant topographer. In 1887 he was promoted to topographer and, since then, has been in independent charge of work, which included the mapping of sections of various States in different parts of the country and of the Nome District in Alaska. In 1901 he was detailed to examine and make a report on the Northwest boundary line between the United States and Canada, in which work he was associated with C. H. Sinclair of the U. S. Coast and Geodetic Survey.

C. E. Smith, until recently assistant chief engineer of the Missouri Pacific-Iron Mountain system, has opened a consulting office in the Railway Exchange Building, St. Louis, for the railway and municipal work. He will specialize in valuations, terminal problems, grade crossing elimination and bridges. He was graduated from the Massachusetts Institute of Technology in 1900 and was engaged by the New York, New Haven & Hartford Railroad, at New Haven, as bridge designer. After occupying this position for a period of three years he was connected for a short period with the Bureau of Yards and Docks, U. S. Navy Department, as a designer, preparing plans for drydocks and navy yard buildings. In 1905 he was engaged as assistant bridge engineer, in charge of maintenance of existing structures and the construction of new concrete arches and steel bridges, including bridges for grade crossing elimination on the Lake Shore & Michigan Southern. From 1905 to 1906 he served as textbook writer and instructor for the International Correspondence Schools, Scranton, Pa., during which period he wrote the course in bridge engineering that is being taught by those schools at the present time. In 1906 he was engaged as field assistant by the U. S. Geological Survey and investigated and reported on the effects of the fire and earthquake on the buildings of San Francisco. He entered the service of the Missouri Pacific in 1907 as bridge engineer and assistant chief engineer, having charge of all bridge and grade crossing work on the system. During the last two years he had full charge of all engineering work, including tracks, bridges, grade crossings, depots and other buildings.

Obituary Notes

William L. Cooley, construction superintendent of the Otis Elevator Company, died in Chicago, May 26. Mr. Cooley was born in Grundy County, Mo., in 1867.

Fred E. Edinger, well known on the Pacific Coast as vice-president and manager of the contracting firm of Shattuck-Edinger Company, died of heart failure in Stockton on May 18.

John McKechney, a member of the contracting firm of Weir, McKechney & Company, of Chicago, died in that city, May 25. Mr. McKechney was born in Quebec, Can., and went to Chicago in 1864.

Appius C. Swain, consulting electrical engineer of San Francisco, died at his home in Berkeley, Cal., on May 20. Mr. Swain was widely known as a gas and electrical engineer in the East as well as on the Pacific Coast. Some fifteen years ago he constructed the plants of Equitable Light & Power Company at San Francisco.

Civil Service Examinations

New York State.—An examination for junior assistant, engineering departments, salary from $901 to $1200, open to non-residents, will be held June 26 at various cities throughout the State. Candidates must be 20 years of age. No application blanks received at the office of the commission after June 18 will be accepted, and application blanks will not be sent out by mail after June 16.

Examinations Previously Announced

Date		See Eng. Record
	Assistant chief utilities engineer, salary $300 to $375; railroad engineer, salary $250 to $333.33; service engineer, salary $200 to $300 per month; State of Illinois	May 22
June 23	Junior railway civil engineers, grades I and II, salary $1200 to $1680 and $720 to $1080 respectively; United States	May 29